# Editorial

BECAUSE of an early press date for last month's issue, my remarks on television were written some time before the magazine reached you. Even while it was on the press, things happened with great rapidity. Mr. Anthony on his return was obviously "on the spot" to declare himself and the Government as to its likely action on television. What he said touched off a verbal conflagration which frankly I thought the Government would avoid for the time being.

It drew from the Labor Party, as I imagined it would, not only a re-iterated voice favoring national television but a public disagreement on the part of Labor's leader, Dr. Evatt. To complete the political whirlpool, we have Mr. Gullett, a not inconsiderable Government member, vigorously questioning the wisdom of the PMG's statements. And we have Mr. Fairhall, who previously was urging television because of its alleged importance to defence, pointing out the many difficulties which television protagonists have been in the habit of discounting. Not the least of his points was that televsion advertising revenue will make big inroads on radio advertising revenue, so much so that a single station in each city shared between a national service and a commercial service might be all we can afford or hope for.

What is the net result? Just this, that at present television is one of the biggest political footballs of recent years. It will remain so for many months. No further clarification can take place until the Labor Party at its meeting early this year decides whether to back Dr. Evatt or Mr. Calwell. This decision may effect the legislation the Government will have to introduce before it can present a television plan. If Labor supports the view that it will wipe commercial interest in television and there is a chance of it being returned at the next election, Australian investors will be faced with a pretty problem. The ultimate rewards of television are likely to be large and no interested party can afford to lose an inch in getting in on the ground floor.

One thing is certain—anyone who really thought television would be easy should be disillusioned. Television is so large that in full bloom it must absorb virtually all our entertainment world, including sport, and drain off a substantial portion of the nation's advertising revenue from radio and elsewhere. In these things it will entirely displace the present more or less stable axis. No one will escape its social implications.

I do not think we have heard the last of those who would like to serve on a board to control the ethics and morals of television programs. They present a big problem. It is certain that if we were to ban everything everybody would like banned, we wouldn't have much left to televise. Some firm guidance on program standard is inevitable, but we must be on guard against too much as against too little. We must act as an adult community, and the impression of our life through the television eye must be a real one. We just cannot shut our eyes to the lessons learned by others in this matter, but we must also beware of draining the essential vitality from our program. It would be extremely foolish to face the future in any other way.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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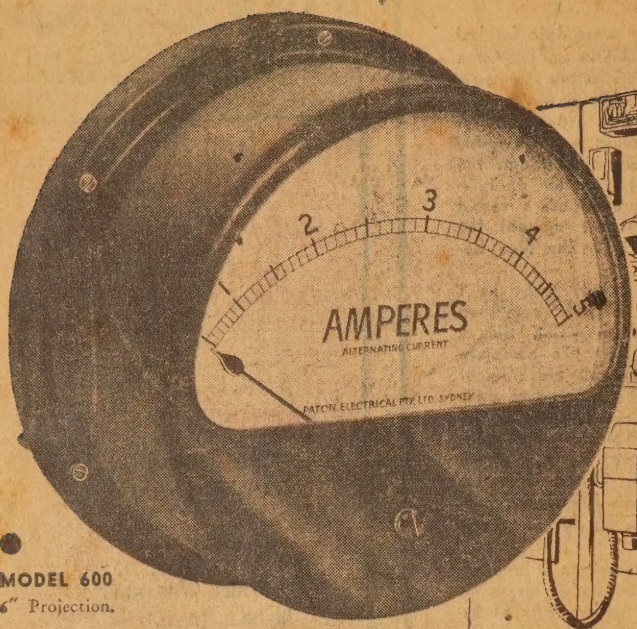
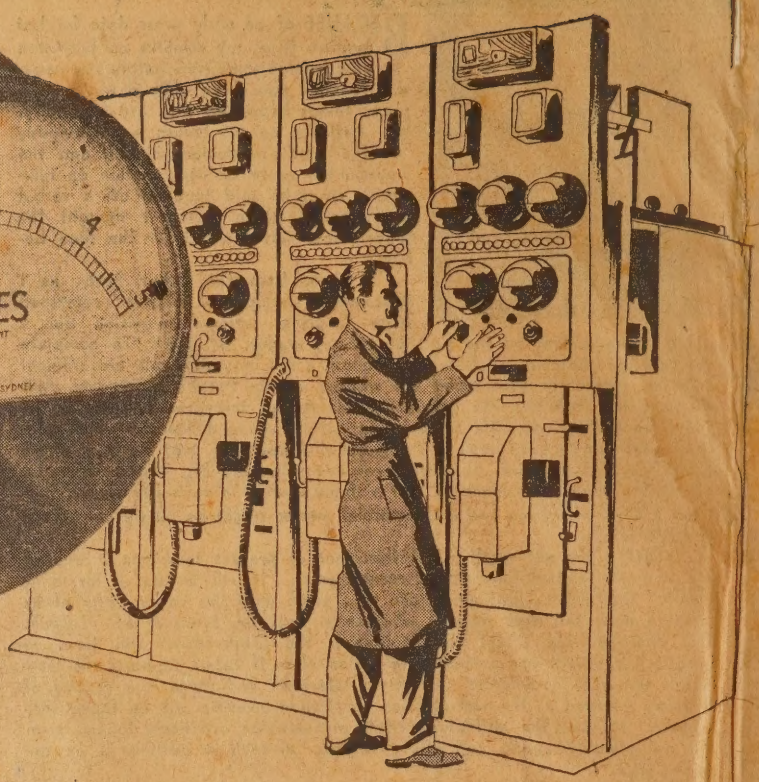
## OUR COVER PICTURE

Our holiday picture this year shows an action shot of Ken MacGregor, tennis champion and sportsman, one of the world's great doubles and singles players, and an Australian Davis Cup star.



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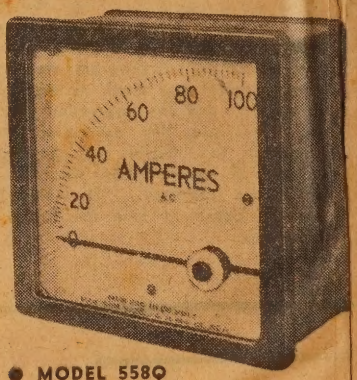


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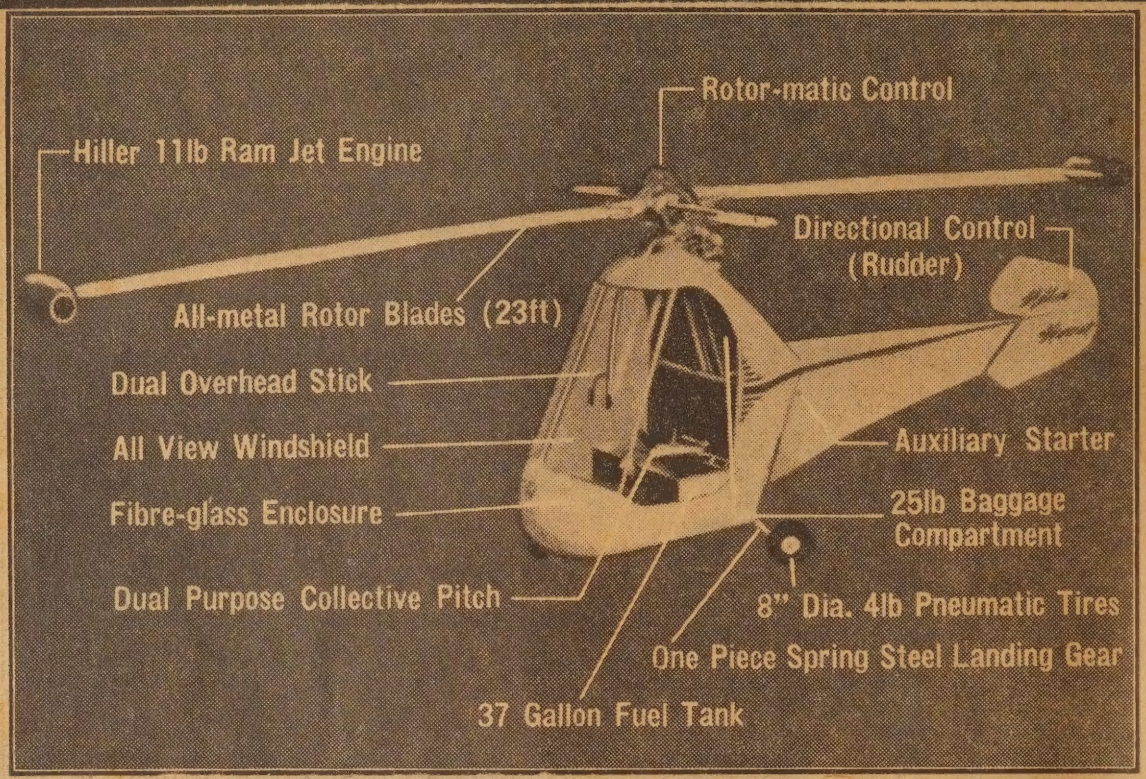
# HIS RADIO SET IS HIS HEADGEAR!

Did someone say that women's hats are silly? Frank Elmore thinks he can compete with them any day. How? Just by joining the ranks of simple souls who build radio sets in their headgear. Note the tuning condenser tastefully protruding from the front like a Brick Bradford atom-gun. The circular aerial-tuning coil has plenty of pick-up.

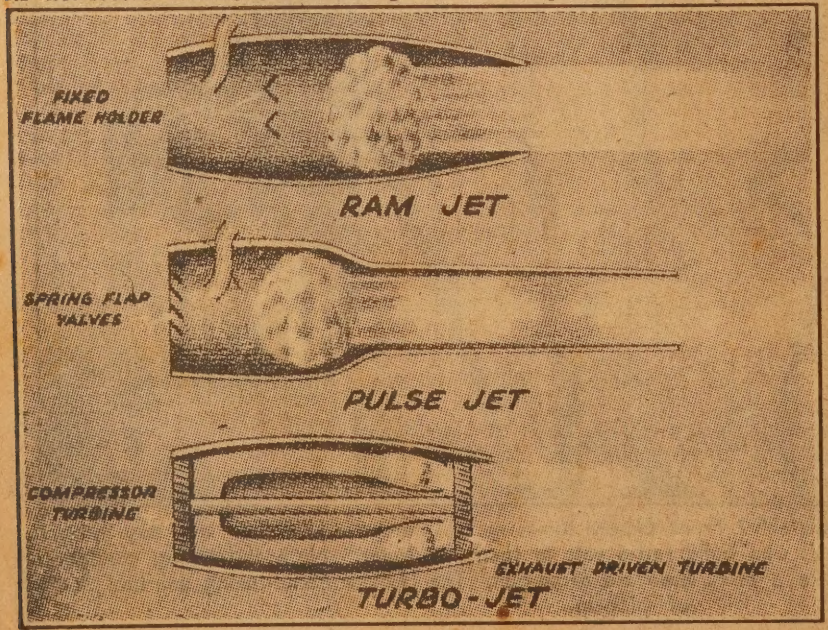
# WORLD'S FIRST BABY HELICOPTER




This diagrammatic view of the machine illustrates its simplicity of construction and control

**While modern aviation has glamorised the jet aircraft and the new realms of speed it has opened up, another phase of flying has made such steady progress that it might eventually fill up the gaps in everyday air service which the fast planes are vacating.**

The helicopter may never break through the sound barrier or lift the speed record from London to New York. On the contrary, while its hot-footed friends are straining their air-frames to go faster and faster, it is the test of a good helicopter that it should do just the opposite. Its whirling blades enable it to perform a unique flying feat—to hover motionless in the air, to descend and ascend vertically, and to alight if required on the proverbial threepenny bit.




Showing the difference between the various types of jet engines.

Today nearly everybody has seen one of these strange looking craft in flight, if not in fact then at least on a newsreel. In the latter case it is more than likely that the helicopter has been a military type rescuing wounded soldiers in Korea, or even lifting marooned unfortunates from a housetop during a country flood.

The standard helicopter uses an engine just about as conventional as those which have driven aircraft for years, the requirement being to keep those large vanes rotating at the correct speed in addition to the little "fan" at the tail which keeps the whole thing steady.

But the Hiller Company in USA couldn't see why helicopters shouldn't be scaled down for easy, personal transport.

## PERSONAL TRANSPORT

After some years of experiment, it would seem that their efforts have been successful. The amazing little craft shown in these pictures combines a hint of Heath Robinson with the essence of simplicity.

The secret of its success lies in the use of ram jet motors to drive the rotor, one mounted at the extreme of each rotor blade. This is in direct opposition to the conventional

# USES SIMPLE RAM JET ENGINES

method of mounting the engine in the fuselage, and connecting it to the rotor by a shaft drive.

There are several types of jet engines, some of which are illustrated herewith. Their main variation is in the air intake method. The turbo-jet used frequently on larger aircraft incorporates a turbine driven from the exhaust gases which compresses the air taken in from the front. A simpler type relies on the movement of the aircraft to build up air pressure at the intake, and has a series of flaps in front of the combustion chamber to seal the entrance during the explosion.

The simplest of all is the straight ram jet, which is no more than a tube narrowed at the combustion end. Although the intake end is not sealed during explosions, the speed of the engine through the air is used to build up enough pressure to concentrate most of the reaction to the rear.

## TIP MOUNTING

The fact that the motors are mounted at the tips of the helicopter blades greatly improves the general efficiency of the design. An interesting point is that if you could place a hand on the front of the engine while it was in operation, the metal would be cool enough for you to leave it there.

Ignition of the fuel is accomplished by a spark plug, and combustion is maintained for the requisite time by suitably placed baffles or flame holders. Thus there are no moving parts in the engine at all.

Each of the motors can be taken off and replaced within five minutes, using only a screwdriver for the job. Weight is only 11lb apiece, with a thrust of 3lb—equal to a 34 hp combustion engine.

In the foreground the helicopter is shown in flight. Behind it is a utility version featuring open type of construction.

The machine has an empty weight of only 356lb for the open utility model, and 396lb for the enclosed model. Both will carry two people. As there is no torque in rotor blades driven from tip-mounted jets, there is no balancing rotor on the tail. Directional control is maintained by a rudder hinged at low angle to benefit from the rotor down draft.

Flying controls are entirely by hand. These incorporate an overhead control stick linking directly to a "wobble plate" which controls the pitch and plane of rotation of the shorter blades or paddles. These in turn control the main rotor blades. This has proved a very simple and reliable system.

This baby helicopter makes one wonder whether the light plane will not some day be supplanted or at least seriously challenged by it. Cruising speed of 70 mph and range with two passengers of 50 miles might yet be improved, while its ceiling of 12,000ft is not likely to prove too small.

There are fewer instruments on the panel of the Hiller-Hornet than on the average automobile, and no foot controls. Photo above clearly shows only four instruments used: (1) tachometer, (2) fuel flow indicator, (3) air speed indicator, and (4) altimeter. Starter button (5) is below altimeter. Hand controls are: overhead stick (6) and collective pitch and throttle (7).

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## GEIGER COUNTER TUBES

The range of Mullard Geiger Counter Tubes includes types for the detection of Gamma radiation and Alpha and Beta particles and photons down to very low energies. All types are halogen quenched having a long life and operating over a wide temperature range. Of special note is the MX103, a low voltage all metal, self-quenched gamma counter suited for portable radiation detectors and along with the other types was developed in collaboration with the Atomic Energy Research Establishment, Harwell.

| Type | Application | Overall Length | Overall Diameter | Threshold Voltage (Max.) at 20°C | Plateau Length (min.) at 20° C | Plateau Slope % per 100V (average) | Operating Temperature Range | Unshielded Background Counts/min. (max.) | Background Counts/min. Shielded 2in. Pb + ¼in. Al | Window Thickness mg/cm² | Dead Time MuS (approx.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MX103 | Gamma Counter | 195 mm | 29 mm | 370V | 100V | 8% | —55 to +75°C | 110 | | 375 | 130 |
| MX108 | Beta/Gamma Counter | 110 mm | 26 mm | 370V | 100V | 8% | " " " | 45 | 20 | 10 | 100 |
| MX113 | Alpha/Beta Counter | 85.7 mm | 14.2 mm | 575V | 150V | 6% | " " " | | 6 | 1.6 to 2.1 | 50 |
| MX114 | Beta Counter | 95 mm | 33.3 mm | 600V | 200V | 6% | " " " | | 40 | 3.5 to 4.0 | 150 |
| MX115 | Gamma Counter | 110 mm | 26 mm | 370V | 100V | 8% | " " " | 45 | 20 | 375 | 100 |

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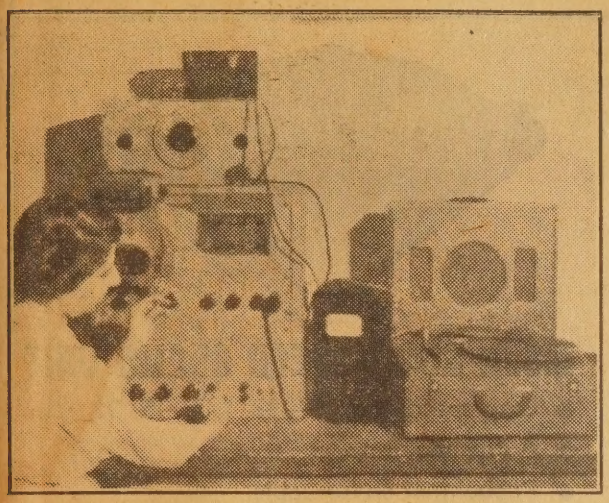
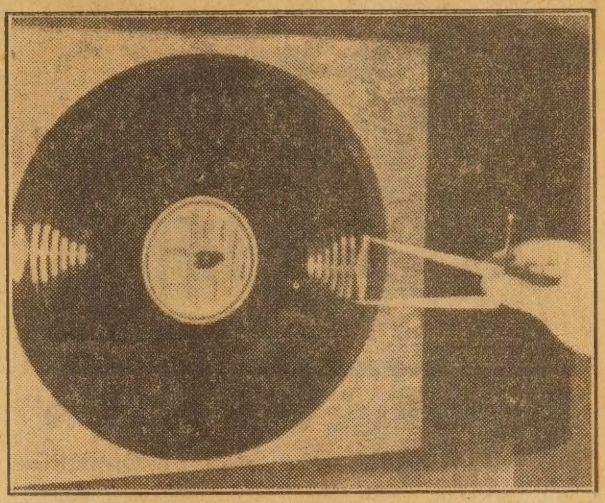
# BOOKS THAT TALK FOR THE BLIND





Left: a spectrographic method developed by NBS provides an effective technique for analysing speech characteristics. Instantaneous spectrograms of individual syllables produced by the record player appear on the oscilloscope screen. The camera above the screen is used to take a time exposure of the successive syllable spectrograms, providing an integrated frequency envelope characteristic of the recording, and reproduce equipment under study. Right: Direct calibration of a talking-book record by reflection of light from the groove faces. Measurements of the triangular pattern produced by a collimated beam of light striking the record from the left are used to compute the modulation of the record at the test frequencies.

**An investigation of the many problems involved in recording and reproducing human speech is being conducted by the National Bureau of Standards of USA.**

IN talking books, high fidelity is especially important because most of the material is unfamiliar to the listener, and he has no easy way of checking his impression of the words he hears against the printed words in the book. Because of this, talking book recordings must have higher fidelity than is usual even in good musical recordings.

Special, high-quality records and reproducing equipment are thus required. As the Library has invested several million dollars in talking books, it requested the Bureau to investigate talking-book production techniques in current use and to set up specifications for the purchase of records and reproducers.

Microscopic examination of the modulation of a test record in the Bureau's sound laboratory.

The program began with the preparation of an interim specification for talking-book phonographs. When sample reproducers were tested for compliance with this specification, large variations were found in such characteristics as tip radius of the reproducer needle, tone-arm force, and loudspeaker response. It was also evident that standardisation of record characteristics was needed; arrangements were therefore made with two of the largest suppliers of talking book records for a co-operative study of their recording techniques, with the ultimate object of developing a standard technique.

Since there were no established methods for testing speech records, it was necessary for the Bureau to devise a new technique for studying speech communication systems.

## "VISIBLE" SPEECH

This technique utilises a time-integrated spectrogram of speech sounds which can be interpreted to show many of the characteristics of the transmitting system.

Although single speech sounds, or syllables, are complex patterns of different frequencies and sound levels, over a relatively short period of time nearly all sound levels and frequencies within the entire speech spectrum are produced.

The characteristics of a recording system can thus be determined by comparing an integrated spectrogram of the human voice with an integrated spectrogram for the recording system.

To provide the necessary sound spectrograms, a commercial spectrograph known as a Panoramic Analyser was modified in the Bureau's sound laboratory. Ordinarily, the Panoramic Analyser sweeps through the audio-frequency range once a second and displays a spectrum of the signal at its input on the face of a cathode-ray tube.

The horizontal co-ordinate of the pattern is a frequency scale: the vertical display is proportional to the amplitude of each frequency contained in the input signal. Because speech sounds change in composition more often than once a second, many of the frequencies present in a sample of speech would not be included in a one-second sweep.

## SPECIAL MODIFICATION

It was therefore necessary to modify the Panoramic Analyser so that it would sweep through its analysis range at the syllable articulation rate.

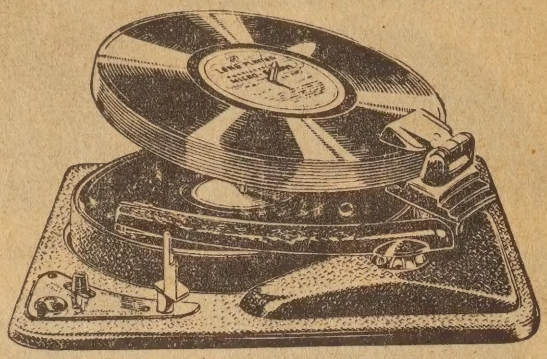
This made it possible to display instantaneous spectrograms of individual syllables on the cathode-ray screen when the equipment was connected to the output of a microphone. By exposing a photographic film for sufficient time (at least 60 seconds) to successive syllable spectrograms, an integrated envelope characteristic of the speech communication system under study is obtained.

A simple optical procedure, previously developed by Buchmann and Meyer in Germany, is used to relate these integrated spectra to the actual characteristics of the talking-book discs as manufactured. In this

**(Continued on Page 9)**

# The WARBURTON FRANKI Page

***Everything for the Radio Hobbyist—Check it each month***



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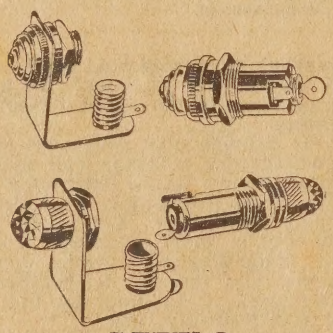

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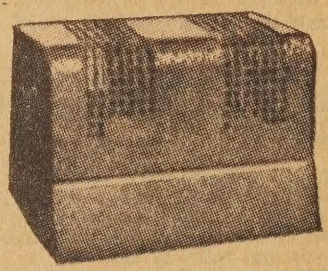

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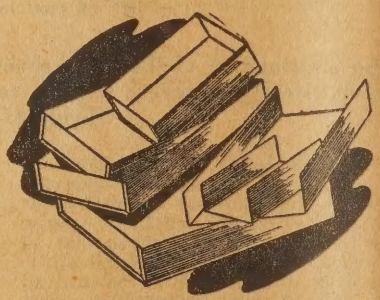

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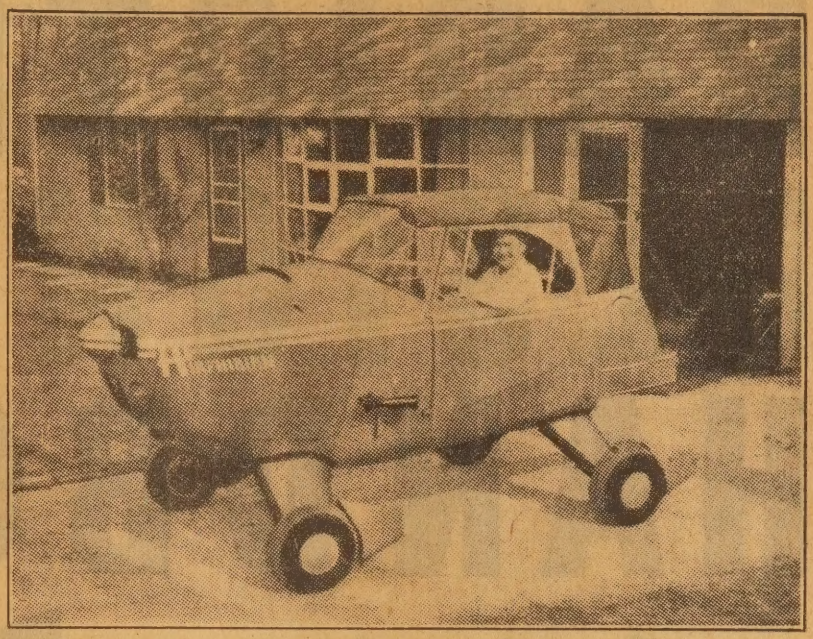
# WOULD YOU LIKE TO FLY A CAR?

**Many of us have often wondered why we couldn't combine a light aeroplane and car to give flexibility to personal transport These pictures show what one man did about it. A nifty little aircraft that sheds its wings on the ground and can be driven about like any other car.**



Leaving the wings behind him at the airfield, the proud owner drives his light car home.

TRUE, it doesn't look much like a car, and has a reputation for stopping the traffic while drivers gape as it whips past. But according to tests it is exceptionally stable on the ground, and because of its high-powered engine—for a car—its performance is fine. It does 50 mph with only 1700 rpm from the motor.

It was designed for a man whose job required a great deal of moving about in a short time. He couldn't buy what he wanted so he designed and built it. Now after a quarter-million miles of air and road travel, he proposed to market his baby.

It has a six-cylinder, air-cooled engine developing 150 hp and will do 50-60 mph on the road for 20 mpg. In the air at 110 mph it uses eight gallons per hour.

It uses powerful disc-type brakes and has independent wheel springing rather harder than usual because it is designed to handle the full weight of landing and take-off. The type of transmission is not disclosed, except that it has a type of hydromatic clutch with no gears as such. Just a lever which goes forward on the drive, and backward for reverse.

The time taken to detach the wings and tail is only a matter of minutes. Special foolproof locking devices are installed, and an indicator light included to prevent accidents. Until the locking mechanism has operated, the machine won't function.

Naturally this wouldn't be a job for everyone. It hasn't the simplicity of controls of the modern motor car and its dashboard, therefore, looks rather formidable. On the other hand, its specialised use means that the average man wouldn't require it.

As a car it weighs 1120lb, and as an aircraft 1520lb empty.

The fact that the machine has received a US Government certificate indicates that it is not a toy, but a perfectly practicable project. Only time can tell whether it will achieve any popularity.

In the air, plus its wings and tail, we have a neat aircraft that cruises at 110 mph.

## BOOKS THAT TALK FOR THE BLIND

(Continued from Page 7)

procedure, the pattern formed by reflection of a collimated beam of light from the groove faces of a record—made up of a series of single-frequency bands—is measured and used to calibrate the modulation of the record directly, eliminating the effect of the reproducer system.

After a test record has been calibrated in this way, the integrated frequency spectrograms of the talking books under study are compared with the spectrogram of the calibrated test record.

The spectrographic method developed by NBS offers a powerful tool for the study not only of speech communication systems, but of the nature of speech itself.

Previous methods for visually observing speech characteristics either required the repeated playing back of a recording in order to make a frequency analysis, or else sacrificed a certain amount of resolving power by using fixed-frequency band filters and multiple channels to obtain the necessary high speed.

The Bureau's method, on the other hand, allows direct observation of the location of the peak frequencies making up speech sounds and of their relative magnitudes with a resolving power equivalent to that of the fixed band filters, but it operates through a single channel.

Thus, the modifications in the structure of the speech sounds produced by either the recording process or the reproducer system may be determined with some precision. In addition, the statistical occurrence of speech sounds and their inherent variability can be studied by this means.

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# RADIO-ACTIVE PEN CHECKS WEATHER

**A pen that writes the weather has proved an accurate means of detecting atmospheric changes tor General Electric Company scientists in USA. The device puts down on paper weather changes ranging from distant summer showers to onrushing thunderstorms.**

WITH the aid of a radioactive point on a slender shaft mounted atop the Research Laboratory, scientists are gauging the electrical activity generated by weather changes as slight as shifting winds. Even variations in intensity of light reflected from clouds sometimes register noticeable changes on the recording mechanism.

Electric current, collecting on the radioactive point from high potential developed between earth and atmosphere, is measured by an extremely sensitive photoelectric recorder located in the laboratory's penthouse weather station.

The tiny stylus of the apparatus moves left when negative charges grow on the antenna outside. Positive charges move the pen to the right. Dead centre is zero potential on the paper chart moving steadily past the red-writing stylus.

With clear skies overhead, small deflection of the delicate instrument correlate well with the outbreak of showers within a radius of 450 miles, according to Raymond E. Falconer, the meterologist working on the apparatus.

On clear days, the pen stays close to the centre line of the chart. But radium-impregnated gold foil on the antenna has made it so sensitive the pen seldom remains at rest.

When thunderstorms move into the area, the pen springs to life. The approach of a storm consistently builds up a negative charge, sending the thin red line far to the left on the ruled paper.

Lightning flashes reverse the pen. It moves quickly to zero, and at times swings over to a positive position. The approach or passage of cold and warm fronts write easily identified patterns on the chart. A build-up on the negative side usually heralds a warm front. A positive reading in most cases identifies the cold.

Freezing and sublimation (the direct conversion of vapor to ice) usually register a positive pattern. Melting and condensation touch off negative activity in the atmosphere.

Advantages looked for by Falconer in the more widespread use of the weather device include closer pin-pointing of cold and warm fronts on the weather map. It also can be used to indicate the presence of fronts high in the atmosphere which otherwise might go undetected. Falconer pointed out, too, that pen strokes across the chart can be used to count lightning flashes in the area.

Sharper short-range weather forecasts may result from the use of networks of these devices in weather stations across the country.

The mechanism ferrets out isolated showers and disturbances not otherwise detected by most instruments now used in ordinary weather stations, he said.

According to Falconer, the equipment can tip off weather men about the presence of disturbances which could be found otherwise only by radar. The device costs only a fraction of the price paid for radar equipment.

Work with the equipment was started in 1943 by Dr. Vincent J. Schaefer, the G-E scientist who discovered that artificial seeding of clouds could cause rain.

## 175-h.p. GAS ENGINE

BOEING Aircraft Company, of Seattle, Washington, has produced a 175-hp gas turbine engine weighing only 200lb.

The company claims that one man can take it apart and reassemble it in six hours, that it runs on diesel oil, kerosene or petrol, occupies only 13 pc of the space taken by a standard diesel truck engine, needs no radiator or cooling system, and has only one-tenth as many parts as comparable petrol and diesel engines of the piston-drive type.

Its fuel consumption is about one mile per gallon, compared with the more economical three to five miles per gallon by conventional truck engines.

This was the average consumption on a 60-hour test-run in which the engine was used to power a truck with a total load of 34 tons.

The company is reported to have tested the engine successfully in a helicopter, and to be planning to try it in an aeroplane.

Present production is for the Navy, for use as electric generators in minesweepers. The Navy is testing it as a power plant for landing craft.

The engine is an adaptation of the jet aircraft engine principle. In a jet engine, the power comes from the thrust of the escaping gas. In the Boeing gas-turbine engine, the gas spins a turbine just as water spins a turbine to make electricity —and the resulting power drives a shaft.

## BODY GRAPH ENSURES GOOD FIT!

An ingenious French inventor has produced this apparatus for simplifying the fitting of suits and other clothing. He is M. D'Angelo, shown here demonstrating his invention with the aid of France's "Miss Elegance" for 1952. The customer dons a special fitting coat with elastic seams. These allow the coat to fit itself to his figure. Sensitized paper strips are then placed under the seams, and exposed to a "luminous ray" from the machine. The tailor now has an accurate record of the garment's true fit. There is no mention of the procedure adopted for a "drape" suit!

The "fingerprint" on the table-top is being made in talcum powder by sound-waves pitched so high that the human ear cannot hear them. The inaudible sound is coming from a tiny whistle on the end of the J-shaped tube in the picture's centre. This sound is reflected on to the table by the concave metal disk. The ridges in the powder are caused by so-called "standing waves" which are points where waves headed for the table-top meet those bouncing back from it, cancelling each other out. At these points there is no activity, and the powder can remain at rest.

# Using Silent Sound

**John Keats in one of his sonnets remarked, "Hear ye not the hum of mighty workings?" The workings of nature are mighty indeed, but what Keats did not know in his time, was the now well-known fact that in nature there is more humming going on than can be heard with the unaided ear. In fact the unheard hums are only discernible with the eye—not the ear, or the nose.**

AWAY up above about 20,000 cycles per second — the highest frequency a good normal ear can hear there are silent 'sound'" waves which, although impinging on our ear drum all the time, are not discernible to us.

It would appear likely that these silent waves may be as numerous as those audible waves which go to make up the sounds we hear every day such as speech, music, and those noises which help to make life unbearable at times.

It is well known that some insects and animals and birds can emit sound which is inaudible to us. These sounds are in the ultrasonic range.

To make a line of demarcation, it is considered that all waves above a frequency of about 20,000 cycles a second are ultrasonic waves.

By means of special apparatus to be described it is possible to generate "sound" waves of the order of 500-million cycles per second.

Ultrasonic vibrations have a rapidly expanding field of application. For instance frequencies of the order of from 20,000 to 100,000 cycles per second are used for submarine signalling and communication. Frequencies of 100,000 to 10,000,000 cycles can be used for detecting flaws in material and for application in medical spheres.

## USED FOR MIXING

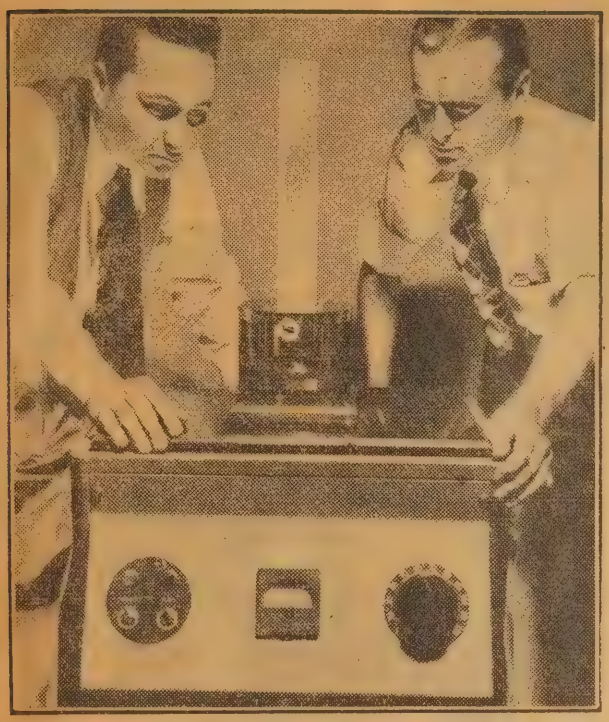
In addition to the aforementioned, ultrasonics are used for purposes such as mixing of otherwise non-mixable liquids, emulsification, destruction of germs, killing of small animal pests, precipitation of smoke, discovery of minerals in the earth, dispersion of metals in liquids, production of heat, stimulation of plant growth and so on.

Although the ultrasonic waves of the higher frequencies have an extremely short wavelength, so short that they sometimes display some of the characteristics of light, they must not be confused with light waves. Ultrasonic waves are "sound" waves pure and simple for they will not travel without the agency of some medium such as air. The means of producing ultrasonic waves are several. The method used is dependent on the power required and the frequency desired.

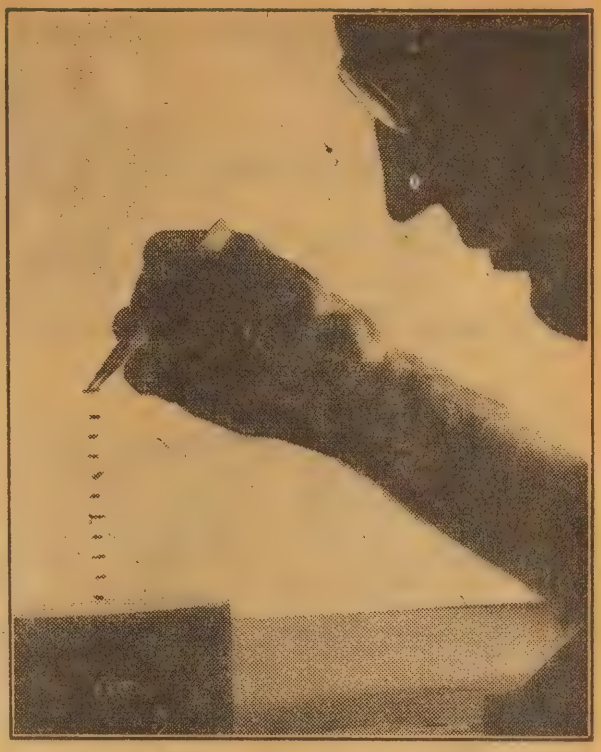
There are whistles, tuning forks and the like which produce sound waves of a low order of frequency but the most commonly used method of ultrasonic generation is by means of crystals such as quartz or Rochelle salt and what is termed magneto-striction.

Magnetostriction is used when frequencies of up to 100,000 cycles are required. Crystals are used for still higher frequencies.

Magnetostriction makes use of the knowledge that, when a metalic rod is suspended in a magnetic field, changes take place in the length of



For use in experiments with "ultrasonics," which are sounds pitched so high that the human ear cannot hear them, General Electric have developed the device above, which generates high-frequency sound waves from a quartz crystal. In laboratory experiments, ultrasonics have been made to homogenize mercury and water, boil water, shatter glass, mix paint, churn butter, and cook eggs, among other things. The quartz crystal, which is about the size of a hockey puck, is contained in the translucent plastic case on top of the cabinet. It is submerged in oil, which insulated the high voltage around the crystal.



George Ledges, General Electric Engineer, suspends bits of cork ladder-fashion in mid-air. In violation of the laws of gravity, the fragments are held aloft by sound-waves, which are pitched so high that they cannot be heard by human beings. The sound is coming from an air whistle, smaller than a cigarette, located two feet above Ledges' tweezers. The waves are focused by a metal reflector to a point just below the bottom piece of cork. Waves coming down from the reflector meet those bouncing up from the metal block to cancel each other out and make still areas, where the bits can remain at rest.

the rod. Thus it will be seen that if the magnetic field can be made to oscillate at any frequency, the rod will vary in length in accordance with that field. In other words the rod will vibrate in a longitudinal direction at the same frequency as the oscillating field.

This alternate lengthening and shortening of the rod will naturally be evident at the ends of the rods so that if the latter is coupled to a diaphragm of some sort, this will vibrate something like the diaphragm of a telelphone earpiece.

The reverse effect also takes place. If the rod is shortened or lengthened by compression or tension, changes will take place in the surrounding magnetic field in accordance with the frequency of compression or tension.

## PICKUP ANALOGY

The nearest approach to a clearer understanding of the matter is to think of an ordinary magnetic gramophone pick up. In this a metal reed is made to vibrate with the grooves in the record. This reed being surrounded by a coil of wire suspended between the poles of a magnet causes fluctuations in the magnetic field and induces a varying voltage in the coils, which is fed to an amplifier and results in audible sound.

Conversly, if a varying voltage is fed to the coil of wire, the reed will vibrate accordingly.

In the pickup the reed vibrates at right angles to its axis. Make it vibrate parallel to its axis and, to all intents and purposes you have a magnetostriction generator.

Experts will no doubt pick holes in the description but it is near enough to illustrate the principle of the thing.

In these generators the rod is

by Calvin Walters

usually made of nickel or nickel iron and is tuned to a particular frequency and magnetised. This tuning is accomplished by grinding the rod to a particular length. For ultrasonic waves of about 20,000 cycles the rod will be about 5 inches long.

As the frequency increases the rod must be shorter so that, at frequencies of about 60,000 cycles, the rod will be about 1½ inches long. This frequency is the highest which is any practical use as, beyond this, the rod becomes so short as to be almost impossible to handle.

The apparatus for the generation of ultrasonics by magnetostriction is, in its simplest form, a magnetised bar tuned to a predetermined wavelength around which is wound a coil of wire. An electronic device feeds into the coil, oscillations of the required frequency. This causes the rod to vibrate lengthwise at the same frequency as the oscillations in the coil. The bar will vibrate at wavelengths other than that to which it is tuned, but will vibrate most strongly at its resonant frequency.

## AS RECEIVER

As currents will also be generated in the coil when the rod is vibrated, it will be seen that the apparatus can also be used as a receiver of ultrasonic waves. Any small diaphragm can be connected to the rod. The rod can be applied to the side of a machine and any vibration of an ultrasonic frequency will be picked up, amplified and can then be made visible by means of a cathode ray tube.

Crystal generators make use of what is called the piezoelectric effect, and here again recourse can be made as an analogy to the phonograph pickup of the crystal type.

The piezoelectric effect is noticeable in thin plates of quartz crystal or Rochelle salt. When a voltage is applied to these plates, they ex-

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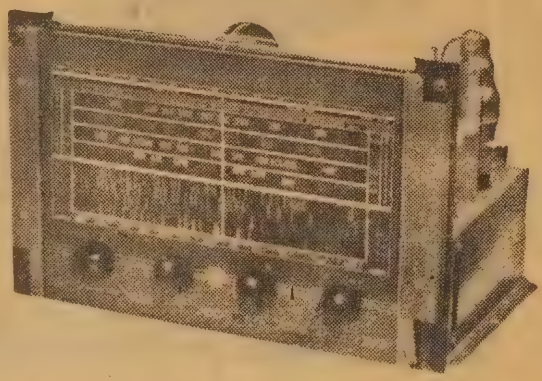

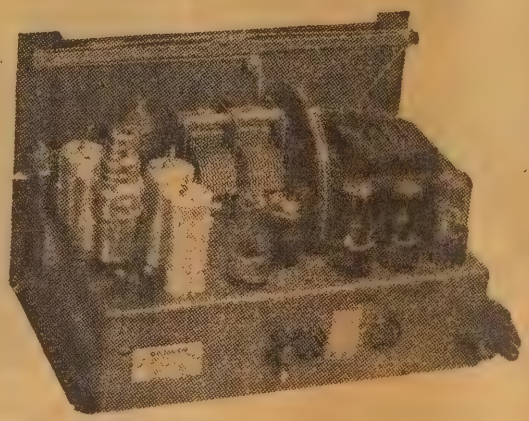

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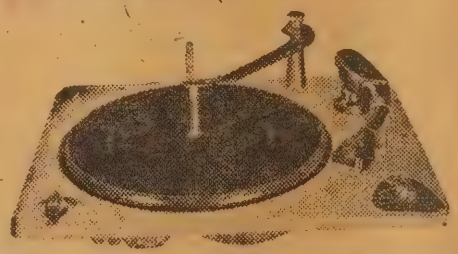

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pand and vibrate. When they are vibrated they will produce an electric current.

Thus in the same way as the magnetostriction generator a suitable oscillator is applied to the crystal which will vibrate at the same frequency. Conversely when vibrated at a certain frequency a current will be generated at the same frequency which can be made visible by a cathode ray tube.

It is not intended here to detail the processes involved in the grinding and cutting of the crystals. It is enough to say that these must be ground with extreme accuracy and cut to a thickness which will respond best to the frequency it is required to produce.

## CRYSTALS

Crystals are mounted in special containers for protecuon and are usually associated with a covering diaphragm. They are often plated with a metallic coating on either side so that suitable electrical contact may be made with the associated circuits.

The crystal type of ultrasonic generator is the most durable, economical and simple of all ultrasonic generators and the most widely used.

Having now given an idea of the methods used for the generation of ultrasonic frequencies we will see what can be accomplished with them. One of the most promising fields is that of agitation of liquids and solids in the chemical and metallurgical industries.

When agitation is to be carried out the crystal is usually immersed in a tank of the metal or liquid to be agitated. Very powerful ultrasonic waves are sent through the material, which is most often a liquid.

If a solid is to be agitated it is usually immersed in the liquid or enclosed in a test tube and placed in the liquid. The waves in the liquid have a very powerful action.

As there is an enormous amount of energy from a properly applied generator very great changes are brought about in the material to be agitated. A great amount of heat is evolved so that it is possible to boil water with these sound waves in a very short time.

In emulsification, two usually non-mixable liquids are so broken up that it appears as if the colloidal state is quickly reached and the two liquids mix to form an emulsion.

## COAGULATION

On the other hand, certain frequencies bring about a strong coagulative action, especially in gases in which are suspended fine solid particles—for example smoke. It has been found that certain very high frequencies will cause the particles to attract each other thus forming a coagulated mass, falling to the bottom of the container.

In metallurgy it is important in most cases that all gas be expelled from a casting of molten metal. This process is called degassing. It is very effectively done by agitating the molten metal with ultrasonic waves of about 200 kilocycles.

With vibrations of about 400 Kc the dispersal of a metal through a liquid has been successfully carried out. Extremely fine particles of a metal measuring only a few micro-centimeters has been obtained.

Photographic emulsions exposed to the waves improve in sensitivity. Color sensitivity is also improved.

## EFFECT ON METALS

Molten metal solidifies more quickly and has a finer grain when ultrasonically exposed. Metals which do not mix may be kept mixed while the mixture solidifies.

The thickness of materials may be measured by means of ultrasonic waves. In this system a wave is transmitted through the material and the frequency of the wave is gradually increased or diminished. A meter in the circuit registers the maximum amount of current when the transmitted wave has a wave-length equal to the thickness of the material to be measured. In other words it indicates the resonant frequency of the material. When this condition of maximum current is reached the calibrated instrument informs us of the wavelength and therefore the thickness of the material.

In the detection of flaws in bars of metal an ultrasonic generator is applied to the material and a pulse sent into it. A receiving crystal is also applied. When the ultrasonic impulse encounters a flaw or a hole inside the material it reflects the impulse back to the receiver. The distance from the transmitter to the flaw can thus be calculated from data giving the velocity of sound in various media. It is based on exactly the same method used in radar and in depth sounding with sonar apparatus in water but the calculating data for radar, is, of course, quite different.

The ultrasonic tester will locate these flaws and holes within a solid mass with extreme accuracy whether the material be a foot thick or ten feet thick. The instrument is called a Reflectoscope and was invented by Dr. F. A. Firestone, of USA.

In the biological field the use of lutrasonic vibration has been attended with much caution. Various claims have been made that these vibrations have been successful in the treatment of cancer, rheumatics and the like but no definite and positive information is available to confirm these claims.

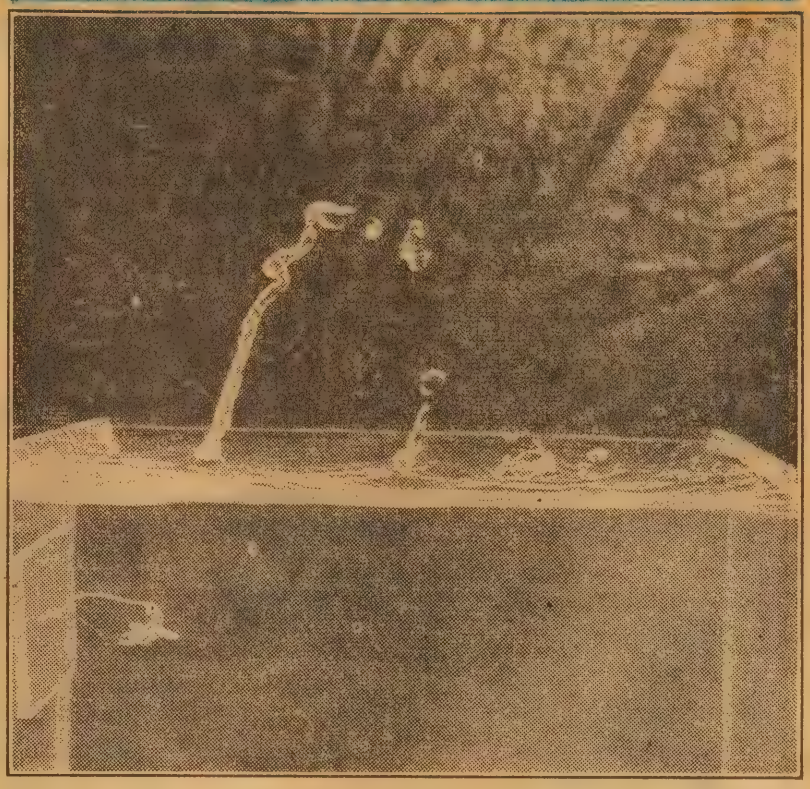
## BIOLOGICAL FIELD

Certain it is that the application of high power ultrasonic waves to the animal body results in some very curious phenomena. Rapid and far reaching changes in body temperature are produced, caused probably by bubbles of gas formed within the tissues. Other manifestations are destruction of reproductive ability of cells. Changes in the character of milk, destruction of bacteria and so on.

In physiotherapy some success has

(Continued on Page 57)

# SOUND BUILDS A WATER SNAKE



Snake-like jet of water spurting from the tank is caused by sound waves with a frequency of nearly three million cycles per second. The ultrasonic waves, sounds pitched so high as to be inaudible, are coming from a small disc in the water clamped between two wires. Because the disc is concave, sound waves are focussed upward and cause geyser when voltage is applied. Picture, taken with a high-speed photoflash, "froze" movement of water.

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Position 1: Radio.
Position 2: LP records.
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Position 4: 78 European records.
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# Technical Review

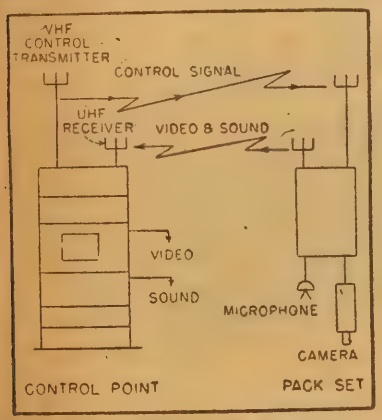
## ONE MAN CARRIES A COMPLETE TELEVISION STATION

**Technical details are now available of a complete battery-operated television station, developed initially for use in the recent US election campaigns. Carried by one man as a self-contained pack set, it can be used anywhere within a quarter-mile of the pick-up centre.**

PORTABLE equipment previously developed has used cable connections which greatly restrict its use. The new equipment is entirely self-contained and contains all the necessary circuitry to generate the information required for a standard 30-frame interlaced 525-line picture.

The information together with the accompanying sound, is relayed back to the control point on a 600 Mc. carrier and ultimately fed into normal TV network channels.

The general design of the system is illustrated in the block diagrams. Figure 1 shows the output from microphone and camera being




A block schematic of the complete system. A conventional small FM circuit conveys instructions to the operator, also 60-cycle sine wave for sync. purposes.

fed via the transmitter to the control point. A transmitter at the control point is used to radio instructions to the operator, which he hears through headphones, if necessary during the course of a broadcast.

The same channel is used to transmit a 60-cycle sine wave to the pack set. This is filtered out from the speech and used to synchronise the pack set's pulse generators to the frequency of the mains and/or the exact frame frequency of the entire TV network.

Figure 2 is a block schematic of the pack set, showing the interconnection of the various units. Free use is made of "pencil" tubes and

The product of research for many years, the pack transmitter weighs 45lb, complete with in-built batteries and dynomotor. The camera weighs an additional 8lb and may be used as shown or mounted on a light tripod for better control A microphone is built into the camera below the viewfinder

☆

midget twin triodes, to conserve space.

Interesting features of the electrical circuit are the use of "boot-strap" modulation and a pulse-time system to carry the sound. Audio frequencies are applied to vary the length of the horizontal sync. pulses.

At the control centre, the sync. pulses are first used for their initial purpose, using the leading edge. They are then run through a low pass filter, which removes the pulse repetition frequency but preserves the energy component, representing the rate of audio variation.

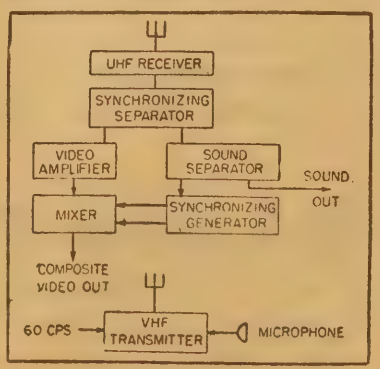



Figure 2: Major sections of the pack set.

By this means, audio frequencies up to 7000 cps can be handled successfully.

Power for the unit is supplied initially by silver cell storage batteries of 60-ampere hour capacity. A dynomotor steps this up to 150 and 250 volts with an efficiency of 60 pc. The load is approximately 150 watts, giving about 1½ hours of operation from a single charge.

The camera uses the well known Vidicon tube.

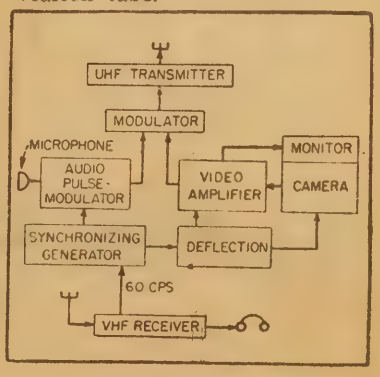
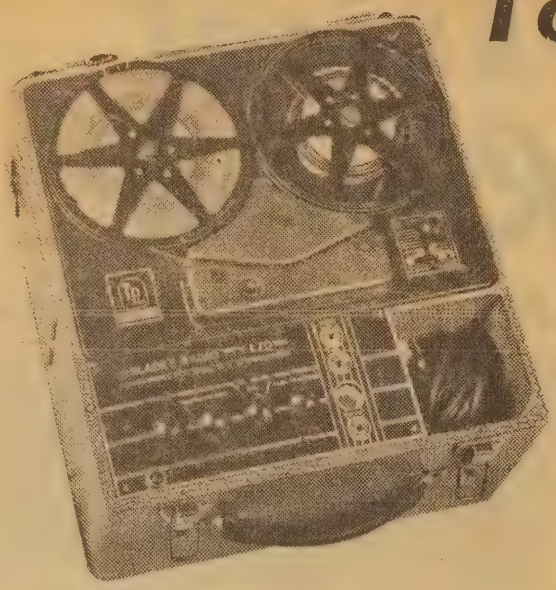



Figure 3: Major sections at control station.



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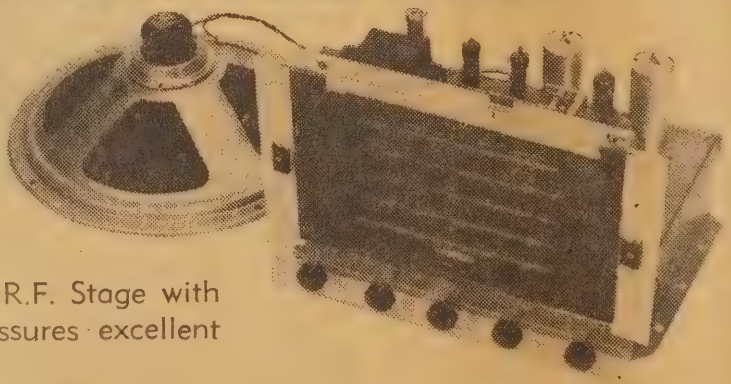

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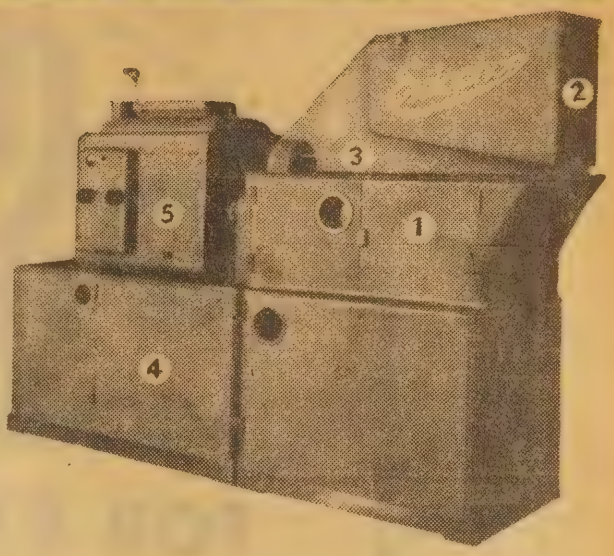
# MORE ABOUT EIDOPHOR THEATRE TV SYSTEM

**Following publication of the basic principles of the Eidophor television projection system in December Radio and Hobbies, some further details have now come to hand. At the same time some comments by Mr. Spyros P. Skouras, president of 20th Century-Fox, during his recent visit to Australia suggest that this system is becoming firmly established overseas.**




The complete Eidophor projector. The numbers refer to the following parts. 1, the projector proper with optical elements and special tube. 2, a light hood. 3, housing for the color wheel. 4, the refrigerator and vacuum pump. 5, the arc lamp.

Points which have now been revealed concern the maintenance of vacuum within the cathode ray tube, some characteristics of the Eidophor fluid together with some precautions necessary for its satisfactory operation, and some details of the method of modulation.

As we suggested in our December article, the mantenance of satisfactory vacuum in the special cathode ray tube, with its rotating mirror and wiping blade, presents a special problem because it would be virtually impossible to retain a high degree of vacuum in the presence of the necessary bearings.

## VACUUM PUMP

It is now revealed that a continuously operating vacuum pump is used, and this also serves to remove any vapours produced by the Eidophor fluid, which would otherwise hinder the operation of the system, both optically and electronically.

The Eidophor fluid is regarded as something of an achievement in itself, many of its characteristics being extremely critical. The exact composition of the fluid is not revealed, though it is said to be a hydrocarbon in some form.

Its two most important characteristics appear to be conductivity and viscosity. The conductivity is required in order that the electric charges produced on its surface by the electron stream may be allowed to leak away, and the rate at which this occurs is also important.

The viscosity is important because the surface of the fluid is required to remain deformed for a definite period, after which it must return to normal as quickly as possible. Since the temperature of the fluid will effect its viscosity, a small refrigeration plant, about the size of a domestic unit, is employed to offset the heat created by the arc and the electron bombardment.

Efforts have also been made to produce a fluid which is completely non-volatile but this has not been completely successful and, in spite of the refrigerator and the vacuum pump there is always a small amount of vapor present in the tube.

## SPECIAL CATHODE

This vapor prevents the use of a conventional oxide coated cathode and a rod of pure tungsten is used. This is heated partly by radiation from a tungsten wire spiral which surrounds it, and partly by electron bombardment from the same tungsten wire, the latter being held at a large negative potential with respect to the rod. This appears to be the only way in which the cathode can be kept small enough to provide a virtual point source of electrons.

The functioning of the Eidophor fluid may, perhaps, be best understood if the rotation of the sperical mirror is, for the moment, neglected, since it appears to be a refinement rather than a vital part of the system.

The electron beam is caused to scan the surface of the fluid in just the same way as it would a fluorescent screen in a normal tube. The physical deformations which it causes on the surface represent the picture elements, and are really the result of small electrical charges on the surface.

The conductivity of the fluid is so adjusted that this charge leaks away in one picture period, while the viscosity must also be such that the deformation will have subsided, and the surface returned to normal, in the same period. Thus it is easy to appreciate why the characteristics of this fluid are so critical and why the temperature must be controlled.

## LIGHT STORAGE

Two important points would appear to be evident from the above explanation: Firstly, as we suggested last month, that the system provides a method of light storage or, more correctly, storage of information to control the light, and that this storage is equal to a whole picture. This is a vast improvement on the Scophony system, which can store up to one line of information, and undoubtedly accounts for the high light efficiency and brilliant color images which characterise the system.

The second point is that the system could, theoretically, operate without the rotation of the mirror and use the same surface of the fluid continuously. In practice this appears to be prevented by the limitations of the fluid and in particular the difficulty of maintaining the surface at a constant temperature while it is being submitted to the electron bombardment and the heat of the arc.

While it may be possible to overcome this problem by using a larger refrigeration plant it appears to be more satisfactory to rotate the mirror slowly so that the surface has time to cool before being used again. The wiping blade is also useful in removing any slight irregularities in the surface which would otherwise mar the picture.

The rotation of the mirror would normally cause some slight distortion of the picture but it would appear to be either so slow that the effect is negligible or else is compensated for in the scanning system.

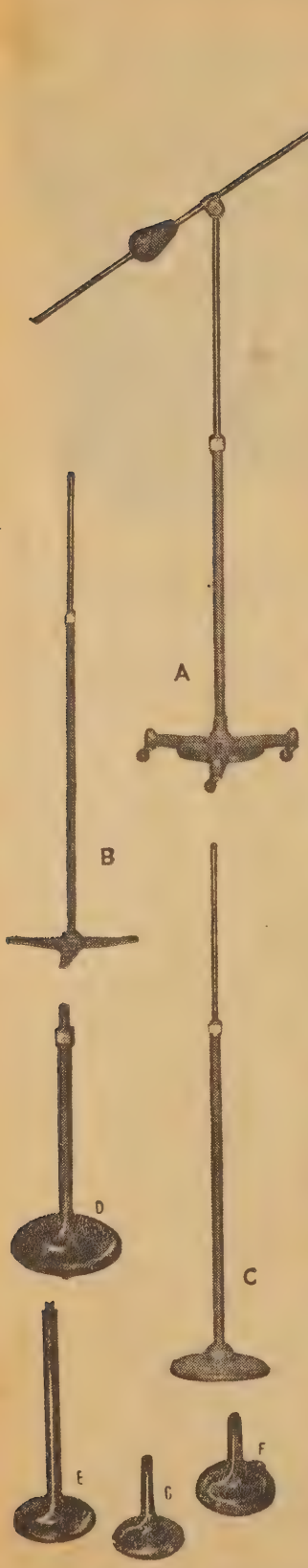
The method of modulating the electron beam is also unique. The beam is not varied in intensity in the usual way but, instead, a process known as velocity modulation is employed. Although published data does not reveal why this is so, it would seem most likely that it is desired to avoid defocusing of the electron stream, with consequent loss of definition of the highlights, which is a problem with normal television systems.

In the velocity modulation system the intensity of the electron stream is kept absolutely constant, while the size and shape of the electron spot is determined by means of a tiny tungsten aperture located in front of the cathode. The electron stream passes through this aperture and a magnetic lens reproduces an image of it on the Eidophor fluid surface.

To provide modulation a pair of deflecting plates are located between the cathode and the aperture and are energised from a constant frequency AC. The amplitude of this AC is made to vary inversely with the video signal strength so that a srong impulse, representing a highlight, produces a weak AC signal. Conversely, a weak video signal, representing a shadow, produces a strong AC signal.

## MODULATION PROCESS

The effect of this AC signal is to sweep the electron stream across the tungsten plate and past the tiny aperture, the speed at which it passes the aperture determining the number of electrons which pass through to reach the picture surface. Thus, when the video signal is weak and the AC signal strong, the electron stream passes the aperture very rapidly and only a few electrons are allowed to pass. When the video signal is strong and the AC signal weak the electron stream takes much longer to pass the aperture and a maximum number of electrons pass through it.

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S4-52

# NEWS AND VIEWS OF THE MONTH

## Radio Counter-measures

A PLAN to keep America's 2500 standard radio stations on the air during air-raids, using their beams to confuse enemy bombers, was announced from the White House.

The plan will be ready in two months.

Wavelength frequencies of the stations will be altered, in emergency, according to prearranged schedule.

The plan does not include television, frequency modulation and amateur radio stations.

★ ★ ★

## German Short-wave Transmitter

THE West German Government hopes that, by Christmas, a powerful short-wave transmitter will be beaming programs abroad "to put Germany across" to foreign listeners.

Government officials emphasise that these programs will not be Government propaganda.

The new radio station will be administered by a three-man committee, on which the Government will have one representative — the head of the Government Press Office, Felix von Eckhardt—and the West Germany's Radio Corporations, too.

Its news and information on political and cultural affairs will, however, "be in general conformity with the Government line."

The new station is a part of a general effort by the Government to gain more influence over broadcasting.

Hitherto, it has had no say in what went over the air, since West Germany's six radio corporations were all set up by the Allies, independently of Government supervision.

The headquarters of the new radio station will be at Cologne.

Programs will be chiefly in three languages — English for Britain and North America, Spanish for Spain and South America, and Arabic for the Middle East.

No attempt will be made to aim the programs east of the "Iron Curtain."

For that purpose a special long-wave transmitter is being installed near Hamburg.

★ ★ ★

## Cosmic Ray Research

ONE of the world's greatest research centres into the nature of matter and energy will be set up in Geneva.

The plan—according to UNESCO Features Press Service—is to build a powerful accelerator for protons rated at 30,000-million electron volts.

This machine will be capable of producing artificial cosmic rays.

Research is designed to explore the structure of the atomic nucleus, the nature of the fundamental particles, and the relations between these particles and energy.

Building of the centre was decided at a meeting in Amsterdam of the European Council for Nuclear Research, consisting of representatives of 10 European nations: Belgium, Denmark, France, Italy, Netherlands, Norway, German Federal Republic, Sweden, Switzerland and Yugoslavia.

All work will be non-military. Results will be freely published and available to the countries.

Major purpose is to enable young European scientists to obtain training in this new field of science, in which equipment is so expensive no single European country could hope to build an adequate institution.

★ ★ ★

## Space Ship News

FIRST man-carrying rocket into space will leave the earth before the end of the century, according to the American Rocket Society.

The meetings of rocket experts were attended by 5000 engineers.

Dr. Fritz Haber, of the Department of Space section of the Air Force School of Aviation, reported that if crewmen were forced to abandon a spaceship, chances of escape and survival would be poor.

Puncturing the hull of the space ship will result in an explosion decompression of the artificial atmosphere maintained inside so that crewmen can live comfortably.

Danger is that members of the rocket crew will be blown out the holes with the escaping air.

If a crewman survives the decompression, Dr. Haber said, survival is linked to other problems.

In interplanetary space, a man can survive—but only for a short time—if he is wearing a pressurised and insulated space suit.

Closer to the earth, gravitational effect would pull a man in a protective suit toward the earth at increasing velocity.

If a crewman fell from 60 miles

## POPULAR SCIENCE QUIZ

*Q. Why has nitro-glycerine so much more explosive "power" than gun powder?*

A. It is due to the molecular disintegration which takes place when nitro-glycerine explodes.

An explosion is a release of energy simultaneous with the formation of a large volume of gas. With the ignition of gunpowder, the volume of gas produced is about 500 times that of the gunpowder used. At the same time the heat liberated by the explosion causes the gases to expand immediately to a volume of about 4000 times that of the volume of gunpowder used. This sudden expansion of gases accounts for the "blast."

Nitro-glycerine produces, on exploding, about 1200 times its own volume in gases which expand with the heat liberated to about 10,000 times. During this process, the molecule of nitro-glycerine is disintegrated or "split," releasing a great amount of heat energy. It is only to be recalled that it is the disintegration of the atom, a component of a molecule, which gives to the atomic explosion its highly destructive force.

*Q. What type of plant is the Pinquicula?*

A. It is a greenhouse plant of the insectivorous variety. Its leaves have a sticky surface, much like flypaper, on which insects become stuck and are eventually absorbed into and digested by the plant.

Another plant which produces the same end result for flies and insects is the Pitcher-plant. Its leaves stand upright, allowing water to collect in the bottom. The secretion of honey at the upper part attracts flies, which upon alighting run a grave risk of sliding down the slippery inner surface off the pitcher to be drowned in the water at the bottom and eventually absorbed by the plant.

★ ★ ★

*Q. What is the Bermudan cahow?*

A. It is an oceanic bird, a petrel, widely believed extinct since 1625. Its discovery was recently reported by The American Museum of Natural History after it was uncovered during a search in Bermuda by the Museum Chairman, Dr. R. C. Murphy, and party.

The cahow is a rather docile bird, about the size of a pigeon but possessing longer wings. It is greyish-brown on top and has a white underbelly. Dr. Murphy reported that it has a black curved beak and its eyes are ringed by black feathers.

It has been a prevalent belief, according to Dr. Murphy, that the cahow became extinct largely because of a shortage of food in Bermuda between 1609 and 1621. He stated that history records that groups of settlers, sent to Cooper's Island at the western end of Bermuda in these years, gorged themselves on the then plentiful birds. It is quite remarkable, in fact, he pointed out, that any cahows have survived the famine-induced slaughter, for not only were the birds killed for food during that period but their eggs were eagerly sought out.

Dr. Murphy makes the point that one of the most distinctive traits known about the cahow is its homing instinct, which apparently leads it back to its nest in tiny crevices at night after flying perhaps 125 miles or more out to sea in search of food. It is believed that the main food of the cahow is squid, which is obtained far out to sea.

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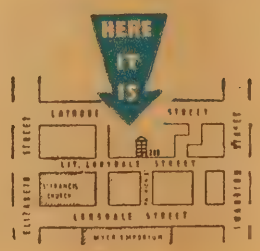
## ON SECOND FLOOR

## 208

## LITTLE LONSDALE STREET




## MELBOURNE — VICTORIA

altitude his falling body would reach a maximum speed of about 500 mph.

The shock of hitting the earth's atmosphere would be like hitting a concrete wall. Heat developed by atmospheric friction would burn a human body.

Dr. Haber said falls from just outside the earth's atmosphere would thus be fatal.

Dr. A. Ehricke, of the Guided Missile Development Group, Redstone Arsenal, Huntsville (Ala.), suggested that the first space satellite to circle the earth could be constructed by space ferries running from small orbital carriers circling the earth at 130 to 150 miles altitude.

The carriers would receive fuel, food and other supplies in small rockets from the earth, and the space ferries would complete the trip to the great man-made satellite.

This schedule may cut a decade off the time required to develop the first satellite, Dr. Ehricke said.

★ ★ ★

## Volcanic Steam Power

VOLCANIC steam, which abounds in Japan, has been successfully harnessed.

After six years of experimenting, engineers of the Industrial Science and Technology Agency of the Trade Ministry recently announced they can generate electricity with steam tapped from subterannean sources.

The first powerhouse using underground steam was to be established on Kyushu, southernmost island of Japan.

The generating capacity of the plant is expected to be 3000kw in its initial stage.

When completed, it is estimated the plant's capacity will be increased to 150,000kw.

If ministry plans are successful, at least 4,000,000,000kwh of electricity a year will be obtained from similar power plants to be built in other volcanic zones.

★ ★ ★

## Safety First

EVERY now and then we come across something which seems to rate a special paragraph. Recently we heard of someone electrocuted so foolishly as to be almost incredible.

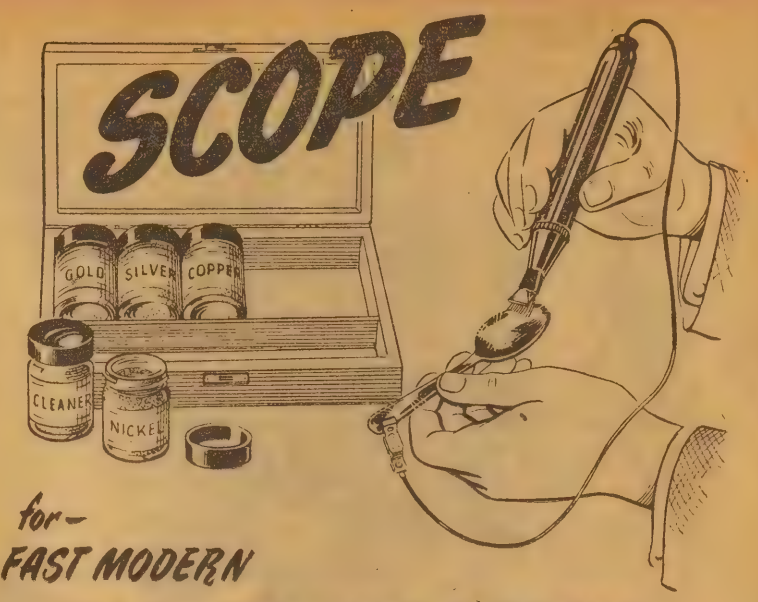
This unfortunate victim was listening to a mantel model radio set while in the bath. Apparently it was precariously balanced, because it fell into the water. Immediately it did so, the water naturally submerged the wiring, including the ends of the wires leading to the power point. The bather never had a chance.

Maybe this incident sounds absurd, but how many of us have used radio sets and radiators, or even electric shavers, under circumstances which exposed us to similar risks?

The chance of electrocution or severe shock in the home are so great that we can only conclude most cases are never heard of.

Electric irons with old plugs cracked and burnt with overheating, electric jugs with loose contacts, electric toasters turned off by pulling out the plug at the toaser, which sooner or later becomes faulty with abuse—we could go on for quite a time. Not forgetting the electric drill used outside on damp ground without a protective earth wire. We all do it from time to time.

Maybe someone reading this paragraph will be inspired to heave out of a guilty chair and look for a screwdriver and insulation tape. Maybe?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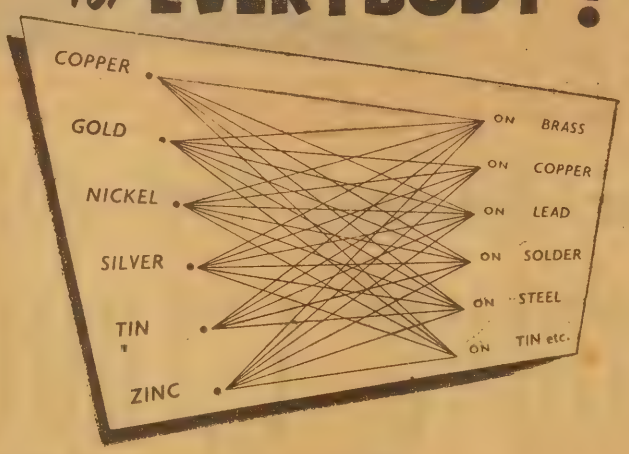


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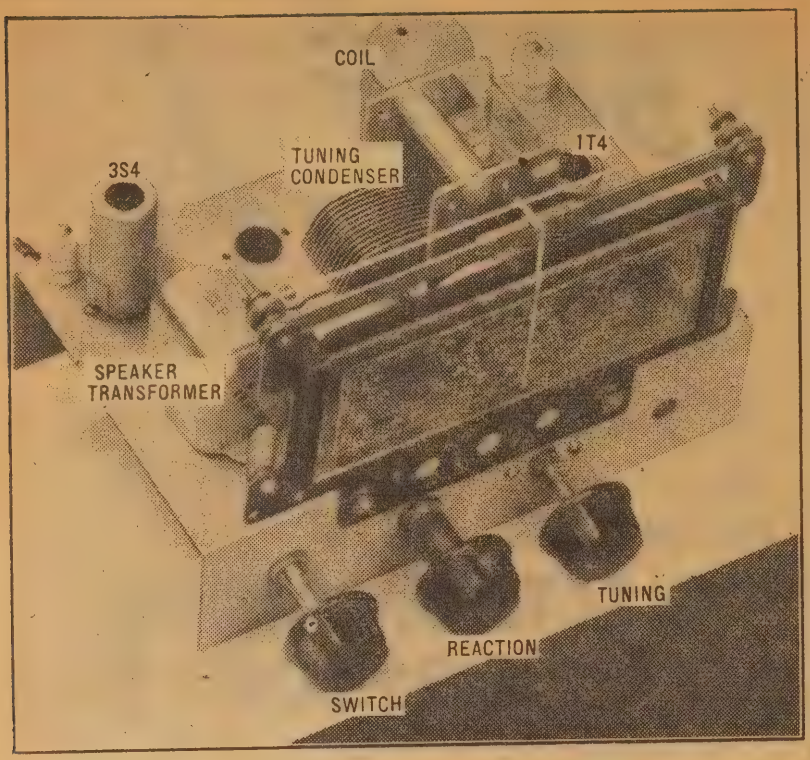



The chassis is the same as used last month. An extra valve socket and the speaker transformer are to been seen at the left. The blank control hole at the right will be used for a wave change switch next month.

## Teach Yourself Radio (6)

# ADDING A LOUD SPEAKER

Now comes the time when everyone can listen in. A second amplifying stage added to our receiver gives it sufficient amplification and sufficient power output to operate a loudspeaker. From the theoretical side, we learn about how the speaker works, about voltage amplifiers and power amplifiers and how bias is applied to the output valve without the need for a separate battery.

by Maurice Findlay

THE main reason for using headphones with the sets we have described up to date is that they require only a very small amount of power to operate them. When you put the phones over your head, the diaphragm is only a few inches from your ear-drum with a result that the diaphragm has only to move a very small amount of air to enable you to hear the sounds it produces.

### HANDLES MORE POWER

On the other hand a loudspeaker is designed so that it is capable of converting larger amounts of electrical energy into sound energy. Its moving parts have to be larger and heavier in order to handle the power necessary for the sounds to be heard at a distance.

Of course the radio set must be capable of supplying the extra power. This is the main problem we will discuss this month.

You are already familiar with the principle of operation of the headphones. The speaker operates in much the same general way. A powerful permanent magnet is fixed to the speaker frame and a coil of wire is fixed to the diaphragm.

When an electric current is passed through the coil it also becomes a magnet and is either attracted to, or repelled from the permanent magnet, depending on the direction of the current. The paper cone being attached to the coil moves with it and disturbs the surrounding air. Thus, the speaker is actually a device for converting electrical energy into sound.

Over the years a lot of research has gone into the design of speakers to make them more efficient and able to faithfully reproduce the sounds required of them. Typical of the arrangement used in modern speakers is that shown in the diagram. You will note how a pair of pole pieces is fitted to the magnet in order to concentrate the magnetic flux on the moving coil. The greater the concentration of magnetic flux, the more efficient the speaker will be.

The method of making the speaker cone is equally important. It must be strong enough to withstand the forces produced by the coil and yet must be light so that it can move quickly enough to follow intricate sound patterns.

### CHOICE OF SPEAKERS

There are a number of excellent speakers suitable for our new receiver that can be bought through the ordinary radio stores so that we will not specify any particular brand.

Most people building a small set like this one like to use a fairly small speaker with it, mainly because it takes up less room. The photograph shows two typical speakers of a type that would be suitable. One has a diameter of three inches and the other five inches.

If you would like to use a larger speaker, there is no reason why not. Contrary to a popular notion, larger speakers are usually more sensitive than small speakers so that you will be able to obtain greater volume from your set.

You may be able to obtain a suitable second-hand speaker at a small cost but if you do try for a second-hand speaker make sure that it is a fairly modern type with good sensitivity. Some of the older speakers are very insensitive by modern standards.

There is one other important point we must discuss while on the subject of speakers.

Radio valves delivering electrical energy are able to do so most efficiently if connected to a special value of resistance, or load. The optimum load depends on the valve, the voltages applied to it and quite a number of other factors that we will not talk about at the moment. In the

case of this month's set, the optimum load happens to be 5000 ohms.

## VOICE COIL IMPEDANCE

In a practical loudspeaker it would be extremely difficult to wind the moving coil in such a way that it would offer an impedance of 5000 ohms, or anything of that order, because the wire would have to be extremely thin.

The solution to the problem is to use a device called a transformer.

The transformer in this particular case has two windings. One consists of a large number of turns of fine wire and the other a small number of turns of thicker wire but both are wound around the same iron core. The currents generated by the valve flow in the coil of fine wire and their action produces magnetic fluxes in the iron core.

The magnetic flux in the iron core produces, in turn, electric currents in the second winding of the transformer. However, this time, because of the ratio of the number of turns in the two coils the voltage is lower and the current higher, the ratio being such that it is suitable for application to the voice coil of the speaker.

## USE CORRECT TRANSFORMER

Different speakers may have different voice coil impedances so that it is always necessary to specify the type of transformer designed to work with a particular valve and a particular voice coil impedance. Sometimes the transformer is mounted on the speaker itself and sometimes on the chassis of the receiver. In our case it is more convenient to mount the transformer on the chassis because, in this position, it can also be used to assist in connecting a pair of headphones should you so desire.

The next thing we have to discuss is the matter of improving the performance of the receiver so that it can supply the extra power required by the speaker.

As you will remember, in the case of last month's receiver, the radio frequency energy received by the aerial is applied to the grid of a valve. It is amplified with the aid of regeneration and appears eventually at the plate circuit of the valve.

The headphones are a very sensitive reproducing device and the signal is strong enough at this point to be applied directly to them. If you were to connect a speaker to the same point, the chances are that you would barely hear the program, so small would be the volume of sound produced.

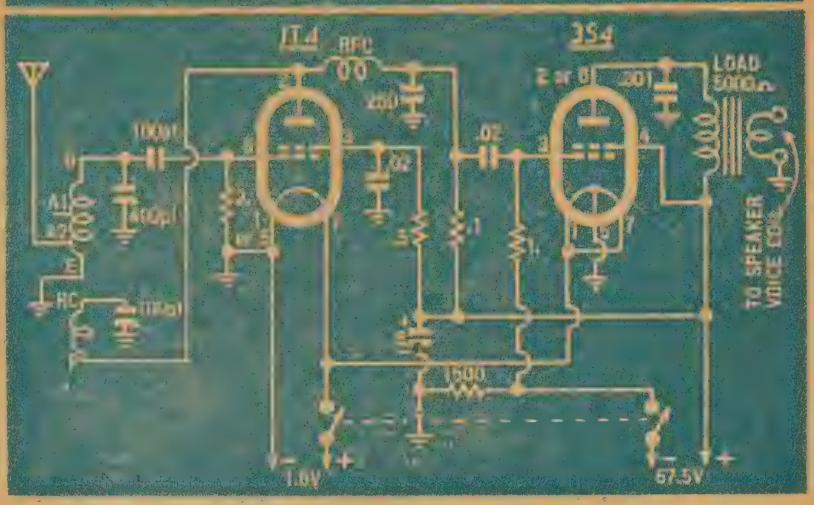
However, a second valve can be connected in such a way as to amplify the output of the first and, as it has a stronger signal to start with, it can produce a very much stronger signal.

## POWER REQUIRED

That is all very well but, as well as giving extra amplification, the second valve must be capable of delivering the power to drive the speaker. And, of course, this power must come from the high tension battery.

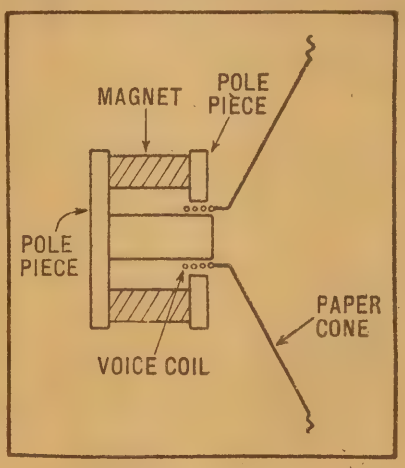
With only 9 volts high tension the 3S4 valve is not capable of delivering anything like sufficient power to operate the speaker and it turns out that a convenient figure for the high

# CIRCUIT OF THE TWO VALVE SET




The set has sufficient amplification and power output to enable it to operate a sensitive speaker in most locations. It is fundamentally the same as its predecessor but with an audio power stage added.

tension is 67.5 volts. This is the maximum value that the manufacturers recommend be applied to the screen. A higher voltage could be applied to the plate but it makes the set much simpler if the same supply is used for both plate and screen.




Cross section of the essential parts of a moving coil speaker.

With a 67.5 volt supply the 3S4 is capable of delivering 0.18 watts of audio power. This means that no matter how much amplification there is in the rest of the set, or how strong the signal received by the aerial, the volume of sound from the set cannot exceed a certain amount.

Although 0.18 watts isn't a great deal of power to people who are used to talking about high powered mains operated amplifiers, it is quite adequate for many purposes, particularly where a modern sensitive speaker is used. Most personal portables, for example, use a 3S4 operating under the same conditions as in this receiver.

The 3S4 was designed especially for feeding loudspeakers, headphones, &c., with good efficiency. However, it is possible to design a valve capable of giving a greater amplification provided it can be fed into the grid of another valve or some system which does not require power. Such a valve is the 1T4.

## THE NEW VALVE

Externally the 1T4 looks much the same as the 3S4. It has the same

## PARTS LIST

1 chassis 8in x 5in x 2in.
1 USL37G dial.
1 400 pf variable condenser.
1 100 pf variable cnodenser.
1 reinartz coil.
1 3S4 valve.
1 7-pin miniature valve socket.
1 1.0 meg. potentiometer (with switch).
4 spring loaded terminals.
1 3 lug tag strip.
3 knobs.
1 ¼in extension shaft.
1 rubber grommet.
1 RF choke (section wound).
1 .001 mfd. fixed condenser.
1 100 pf fixed mica condenser.
1 2.0 meg. ½ watt resistor.
1 1.5 volt battery.

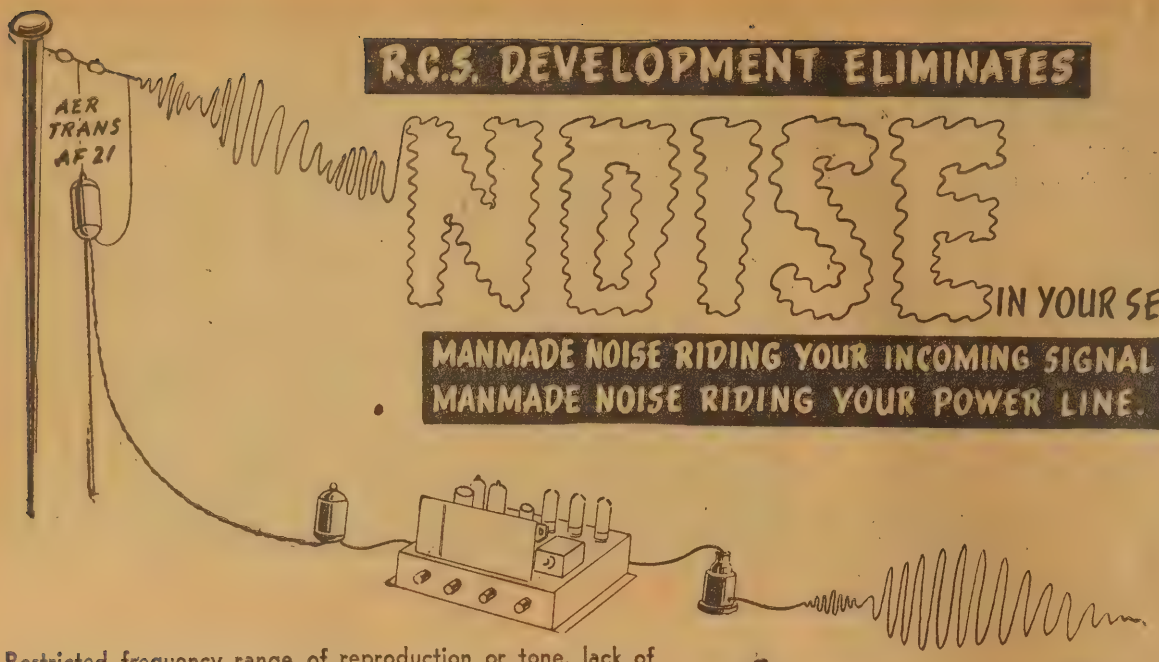
The extra parts you will need to buy for this month's set are listed below.

1 1T4 valve.
1 7-pin miniature valve socket.
1 8 mfd electrolytic condenser.
2 .02 mfd paper condensers.
1 250 pf mica condenser.
1 1.0 meg. resistor.
1 .5 meg resistor.
1 .1 meg. resistor.
1 1500 ohm resistor.
2 tag strips (three or four lug type).
1 speaker transformer (5000 ohms to speaker V/C).
1 67.5 volt battery (miniature type).

Hook-up wire, tinned copper wire, solder lugs, solder, flux, nuts and bolts, &c. See last month's issue for details of the home wound coil.

# R.C.S. DEVELOPMENT ELIMINATES

# NOISE IN YOUR SET




Restricted frequency range of reproduction or tone, lack of sensitivity due to poor listening levels are unknowingly too frequently caused by man-made local interference, such as blackouts and emergency lighting plants cutting in. Faultless sets often emit background noise and chatter which is usually due to bad installation and man-made interference entering both the aerial and R.F. stages of the circuit through the aerial terminal and the power line.

## R.C.S. ELIMINATES TROUBLE

This amazing new R.C.S. development eliminates outside man-made interference. Hear, for the first time, the true reproduction qualities of your receiver.

## AERIAL FILTERS

AF21—The aerial filter consists of two transformers — one is situated close to the aerial, the other close to the aerial and earth terminal. Your set requires no alteration whatever and any amateur can fit the R.C.S. aerial filter in half an hour.

## LINE FILTER

LF20—The R.C.S. line finter can be installed in a matter of minutes. It cuts in on any convenient position in your power line.

***For the best possible performance in your set INSTALL the BEST AVAILABLE COMPONENTS —R.C.S.***

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P.M. Coil.

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Padding condenser.

Resistors.

Standard broadcast coil.

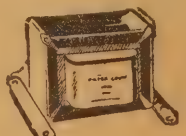
Speaker transformer replacement coil.

Transposition block.

Radio frequency choke.

Loop aerial coil.

DA7 dial.


Filament transformer.

Potentiometer.

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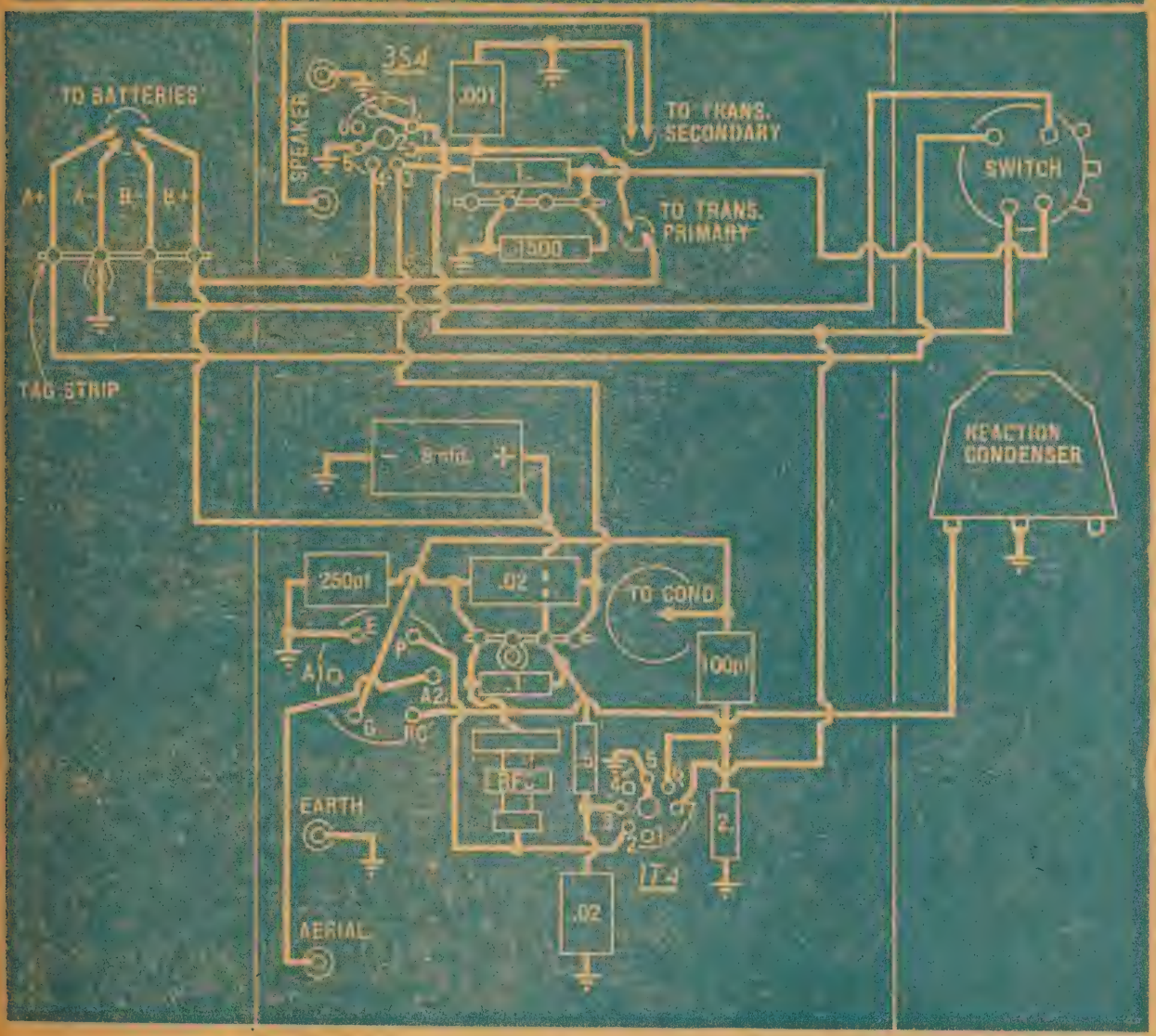
# WIRING DIAGRAM OF SET WITH NEW AUDIO STAGE




We have prepared this wiring diagram to assist those who aren't able to follow the schematic circuit with full confidence. Some parts have had to be moved slightly from their original positions to enable them to be drawn but every connection is shown.

type of base and the glass envelope is similar. However, the filament, grids and plate of the 1T4 are designed to give it the required characteristics.

The 1T4 isn't required to handle much power which, in turn, means that it need not have a great deal of emission and a filament requiring less power than in the case of the 3S4 is suffcient. It requires .05 ampere compared with .1 ampere for the 3S4.

In the two-valve set, therefore, the 1T4 is connected as the detector and the 3S4 is used to feed the speaker. The essentials of the detector circuit are the same as last month so that there is no need to explain them again.

The point that may puzzle you is the method of transferring the signal from the plate circuit of the 1T4 to the grid circuit of the 3S4. There are several standard ways in which this can be done.

For example, a transformer could be used, one winding being connected to the plate circuit of the 1T4 and the other to the grid circuit of the 3S4. The idea is similar to that used to connect the plate circuit of the 3S4 to the loudspeaker voice coil except that the secondary winding of the transformer would be required to have a large number of turns.

## RESISTANCE COUPLING

However, in practice it is difficult to design a transformer suitable for the 1T4 as a pentode and a method known as resistance capacity coupling is the best solution. A resistor is placed in the plate circuit of detector valve and, of course, the plate current has to flow through this resistor. As you know from the previous discussion the plate current varies in sympathy with the audio signal so that the current flowing through the resistor varies with signal.

Here comes the important point. The current flowing through the resistor causes a voltage drop across it and this voltage drop is also varying in accordance with the signal. We can now wire a condenser from the plate circuit of the 1T4 to the grid circuit of the 3S4 of such a value that it will pass the audio signal but prevent the steady voltage on the plate of the 1T4 from appearing at the grid of the second valve.

Finally, it is necessary to maintain the grid of the 3S4 at a steady potential. With 67.5 volts conected to both grid and plate of the 3S4 the amount of plate current drawn by the valve would be excessive if the grid were maintained at ground potential.

The manufacturers recommend that under these conditions the grid be maintained at a potential of minus 7 volts with respect to the filament. This could be done by connecting a 7-volt battery, the postive terminal to earth and the negative terminal to the grid return resistor.

Some years ago it was quite the fashion to use bias batteries in cases

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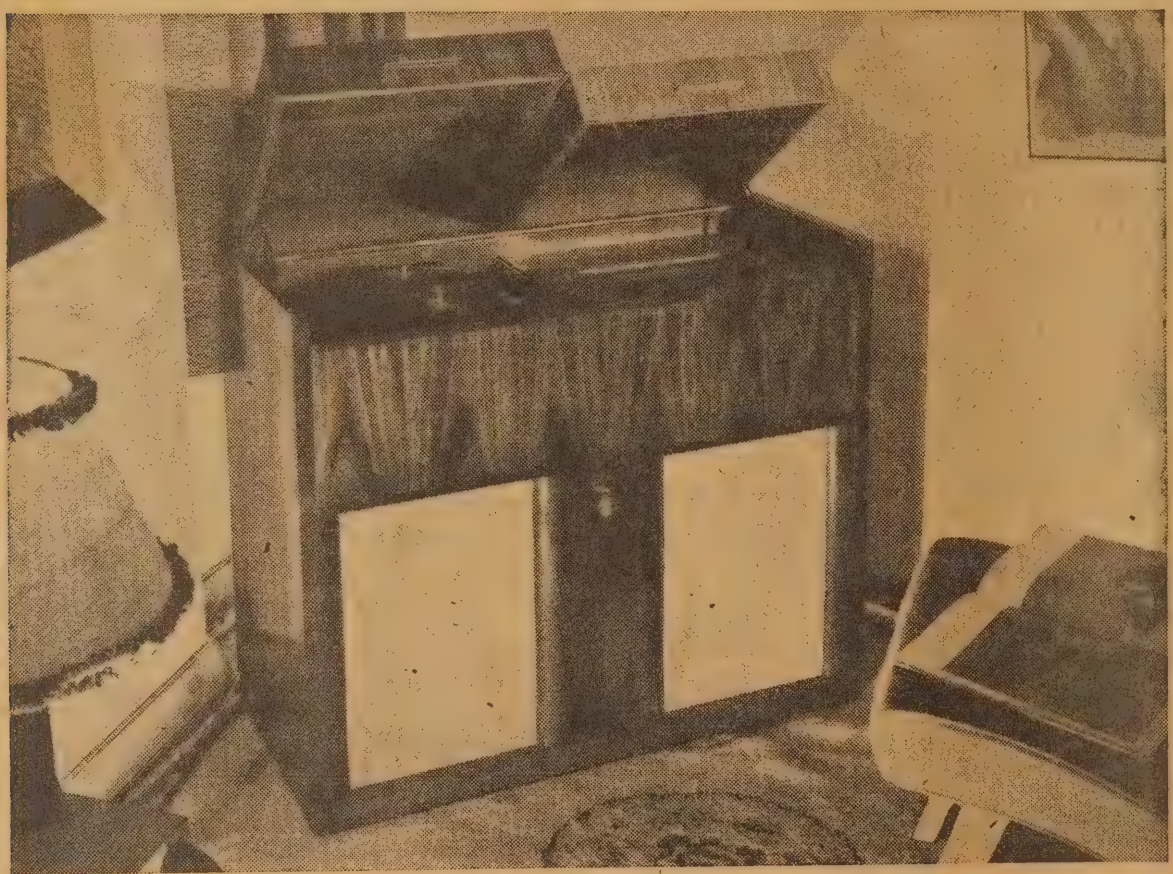

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like this. However, it is quite easy to arrange for part of the potential of the high-tension battery to be subtracted from the plate circut and used as bias for the output valve.

## BIAS CIRCUIT

If a resistor be wired between the negative terminal of the high tension battery and earth the plate and screen current of the valves will have to flow through the resistor There will then be a voltage appearing across the resistor, its value depending on the current flowing and the value of the resistor. If we wish to vary the voltage appearing across the resistor then, we only have to vary its value

The end of the resistor connected to the negative terminal of the battery will be negative with respect to the other end, which is connected to earth. Therefore we can use the former as a return point for the grid resistor of the 3S4 and achieve the desired result.

This system is generally known as "back-bias" and it is very frequently used in battery sets these days because it obviates the need for a separate bias battery. It has the disadvantage that the bias voltage is subtracted from the available high tension In our case, for example. the bias required is minus 7 volts The high tension battery has a nominal potential of 67.5 volts so that the effective high tension available for the valves is 60.5 volts.

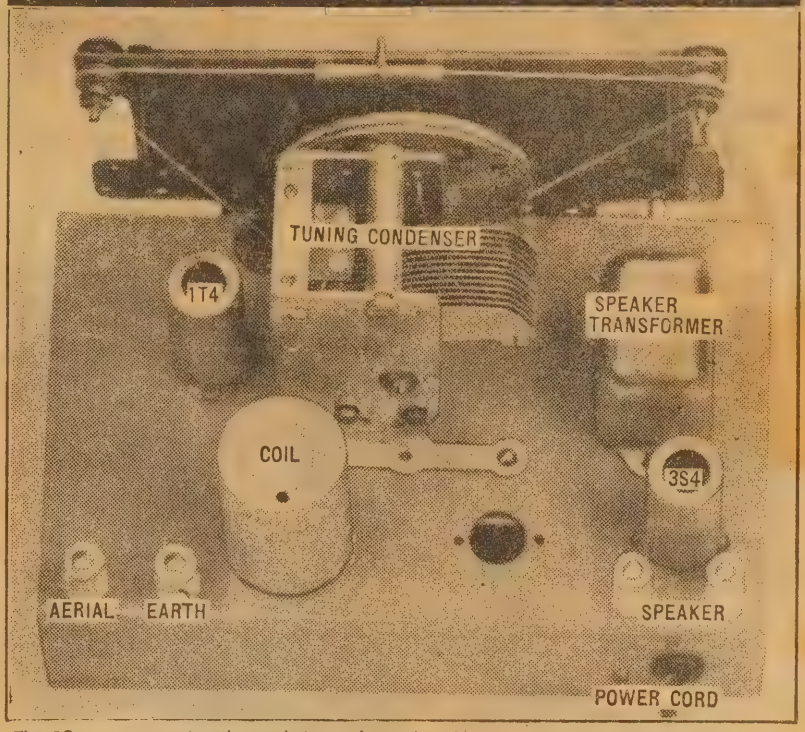
## LARGE CONDENSER

As a final precaution. a condenser of fairly large value is connected from the positive terminal of the 67.5 volt battery to earth. Its purpose is to provide the low resistance between the high tension positive circuit and earth for all audio frequency signals.

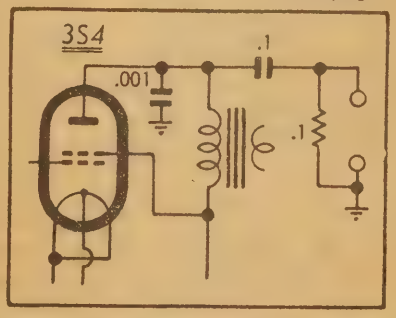
That about covers the theoretical side of the additions to the receiver. It now remains to convert the ideas into a practical radio set.

Very little in the way of mechanical additions is required. There are a number of additional small wiring components and you will find it desirable to install a couple of tag strips. We mounted a three lug tag strip near the 1T4 socket and another near the 3S4 socket. If the set is to be stable and satisfactory to operate it is important that all components be firmly secured in place.

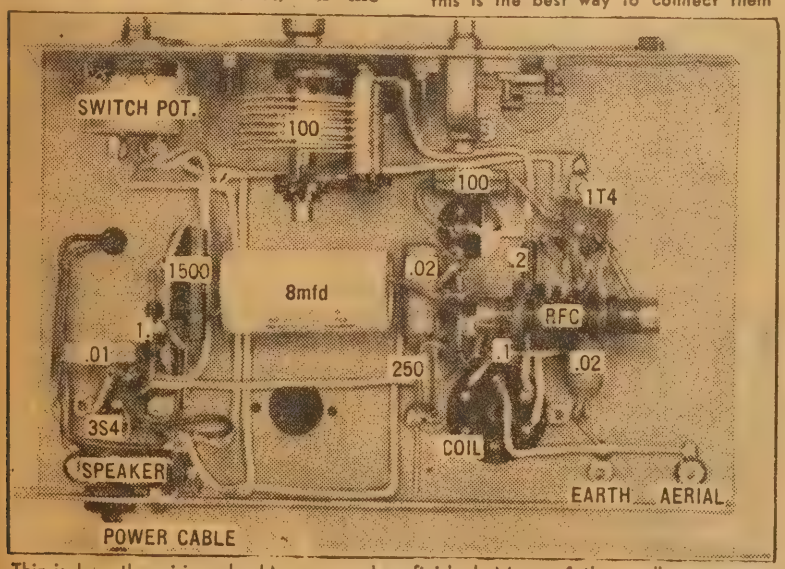
## TOP VIEW OF THE TWO VALVE SET




The 3S4 now occupies the socket on the right while the 1T4 is alongside the tuning condenser. The blank hole between the coil and the 3S4 will be used for an extra amplifying valve next month.




If you wish to use phones with the receiver, this is the best way to connect them




This is how the wiring should appear when finished. Many of the small components are supported by two tag strips, one near the 1T4 socket and the other near the 3S4 socket.

## USE SCHEMATIC CIRCUIT

The schematic circuit and wiring diagram will help you with the various connections. As we have said before, try to work from the schematic circuit because wiring diagrams are rarely prepared for larger sets and when you get used to schematic circuits they are actually much easier to use than wiring diagrams.

Some of the connections from last month's receiver will not have to be changed, but you will note that the connections for the 1T4 bear little similarity to those for the 3S4. The 1T4 now occupies the socket previously occupied by the 3S4.

It is very desirable to break the connections to the 67.5 volt battery as well as the 1.5 volt battery in this set, so that we have used the second switch section on the potentiometer to do this. The potentiometer proper is still unused.

Some readers, who perhaps live a long distance from a radio station or possibly do not wish to buy a speaker at the moment, will wish to use headphones with the set. You could simply connect the phones in place of the primary winding of the speaker transformer and the set would work very well. The objection is that the plate current of the output valve then passes through the fine windings of the phones and further, if the phone leads happen to accidentally touch an earth point the high tension battery will be short circuited.

We have drawn an alternative circuit diagram which shows a good way of connecting the phones and which

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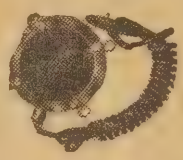

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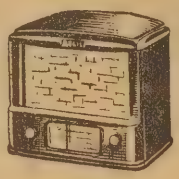

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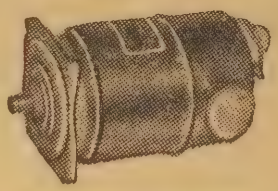

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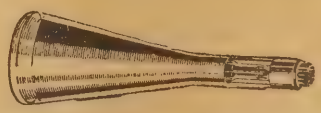

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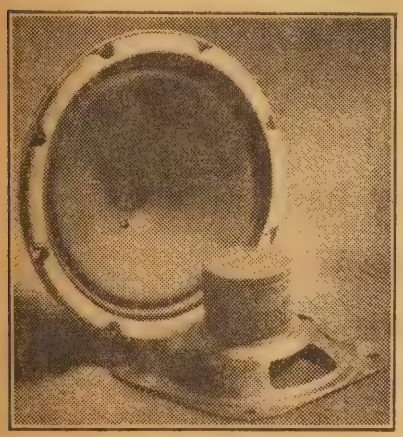
overcomes the above objections. It requires an extra condenser and resistor. Actually, by installing an extra terminal, you could arrange things so that either the phones or the speaker could be connected at will.

## SPEAKER OR PHONES ?

Wire the set as shown for phones and then connect one of the transformer secondary leads to the earth terminal and the other to the third terminal. If you wish to use the speaker connect its voice coil leads between this terminal and earth Don't try to use both phones and speaker at the same time, because you will not get best efficiency from either.

If you intend to use the phones most of the time, say for listening to stations a long way away, the bias on the output valve could well be increased. This would decrease the battery drain and so make the 67.5 volt battery last longer. Simply replace the 1500 ohm back bias resistor with a resistor of 2000 ohms. This will effect a substantial saving.



Two speakers, typical of types that would be suitable for the new set.

There are plenty of situations in which this set will not have a sufficient reserve of gain to allow the speaker to be used to best advantage and many readers will like to add another audio amplifier to increase the volume of signals received from weak stations. This is what we intend to do next month.

The extra audio amplifier will be particularly valuable when we add a switch and short-wave coil as we also intend to do next month. Short-wave reception opens up a whole new world of interesting experimenting, so be sure not to miss next month's issue.

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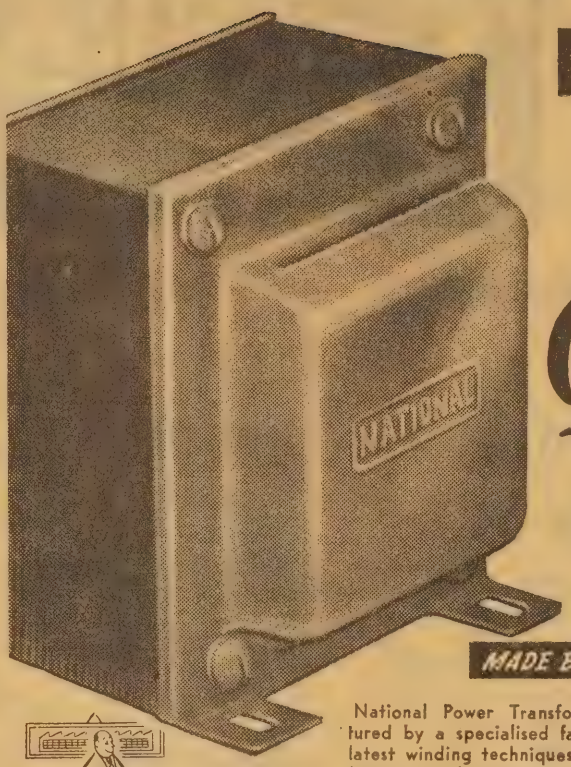

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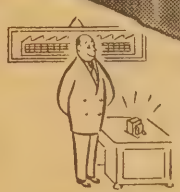

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# REVIEW OF AMPLITUDE MODULATION

**Amplitude modulation is easily the most commonly used method for transmission, and its correct use is vital for best results. This article, forms a valuable review, particularly for amateur transmitters or those aspiring to pass the AOCP examination.**

## PART 1

THE three common methods of superimposing an audio-frequency component upon a radio-frequency carrier wave are termed *frequency modulation*, *phase modulation*, and *amplitude modulation*. Radiotelephony and some forms of tone telegraphy are made possible by modulation processes.

In amplitude modulation, the carrier frequency is maintained constant while the carrier amplitude is varied at the audio rate. Neither frequency nor phase is more than slightly disturbed in efficiently operated systems.

Amplitude modulation is widely used. Each of the standard broadcast stations and most of the radiotelephone communication stations

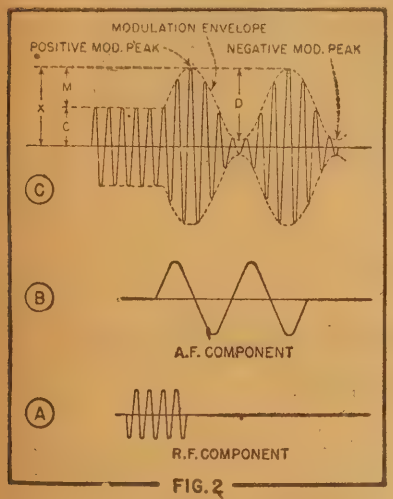

FIG. 2

now in operation employ this method. Moreover, amplitude-modulated signal generators are used to align and test several million of the receivers in current use.

The appearance of an amplitude-modulated carrier is shown in Figure 1. This illustration shows the carrier voltage or current wave before and after application of the modulating component. It is seen that both carrier and audio voltages are alternating components of widely different frequency.

When the two are combined in the process of amplitude modulation, the amplitudes of successive positive and negative carrier peaks are altered in accordance, so that the "moulded" carrier traces out an envelope corresponding to the frequency and relative voltage of the audio component.

The relationship of carrier and modulating voltages or currents and frequencies of these components is shown in Figure 2. A radio-frequency carrier before modulation is shown in 2-A, the modulating voltage wave in 2-B, and the completely modulated carrier in 2-C.

In order to combine the audio and carrier components in the modulation process, the alternating af voltage is actually superimposed upon one of the dc operating voltages of the rf amplifier or oscillator, generally the plate or grid voltage.

Accordingly, the AC and DC voltages add on one half-cycle of audio voltage and buck on the other half-cycle. This results in an increase in the normal DC voltage in the first instance and a reduction in the second case.

In consequence of this action, a variable DC voltage is applied to one of the RF tube electrodes, and the RF carrier voltage and current will be varied at the same rate.

### COMPLETE MODULATION

For complete modulation, as depicted by Figue 2, the carrier amplitude is increased throughout the modulation envelope, to a maximum value equal to twice the unmodulated carrier amplitude and reduced to a minimum value of zero.

In the conventional system operating ideally, both positive and negative carrier peaks are affected by the same amount, and the carrier frequency and phase remain unaltered.

In Figure 2-C, C is the unmodulated carrier amplitude and M the amplitude of the modulating voltage. The diagram shows the condition of complete modulation, i.e., M=C, and X=2C.

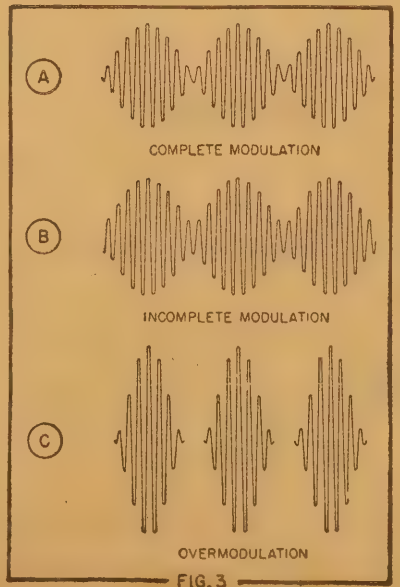

FIG. 3

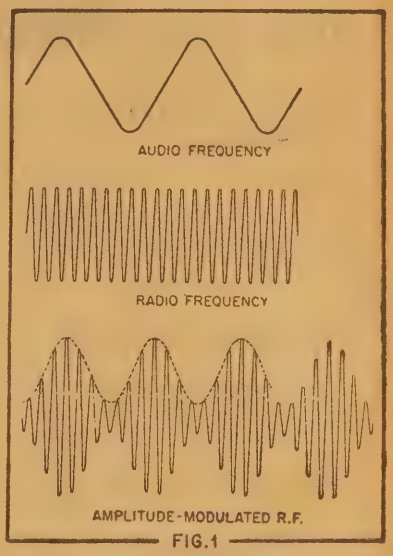

FIG. 1

From the relationships shown, it is evident that lower values of M than that shown would fail to raise the carrier amplitude to an instantaneous value of twice its unmodulated value on positive peaks of modulating voltage, or to reduce it entirely to zero on negative peaks of modulating voltage.

Similarly, higher values of M would raise amplitude C to a level more than twice its unmodulated value while completely cutting off the carrier for brief intervals during the negative modulation swing. The carrier would disappear completely at the zero line, the negative modulation peaks being lost. Consequently, the dimension D is useful for indicating the extent of the process, or *modulation depth*.

### MODULATION DEPTH

The degree of modulation is useful information. The effective value of amplitude-modulated current increases with modulation depth. In practice, the depth of modulation is determined conveniently from the ratio of modulated to unmodulated carrier amplitudes. This ratio is known as the *modulation factor*.

From the diagram of Figure 2, the modulation factor may be expressed as M/C. However, when measurements are made of successive modulated and unmodulated amplitudes, as with an oscilloscope, it is more convenient to measure each of these amplitudes with reference to the zero line rather than with respect to each other. This is because the original carrier amplitude disappears from the screen (or meter scale) during modulation.

When measurements are made from zero, M is equal to the differ-

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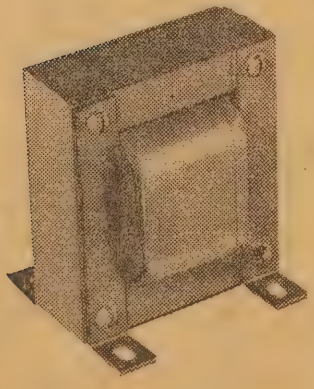

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ence between the modulated and unmodulated carrier amplitudes, and the equation for modulation factor becomes:

$$(1) \qquad \text{Modulation Factor} = \frac{X-C}{C}$$

These amplitude values are determined by means of a peak-reading vacuum-tube voltmeter connected across an appropriate tuned circuit, resonant to the carrier fequency, or they may be taken diectly from an oscilloscope screen in any desirable linear units of measurement.

In complete modulation, the modulation factor is 1.0. This follows from the requirement that the completely modulated carrier amplitude be exactly twice its unmodulated value, its ratio being unity.

The *percentage of modulation*, common term for expressing modulation depth, may be obtained by multiplying the modulation factor by 100:

$$(2) \qquad \% \text{ Modulation} = \frac{X-C}{C} 100$$

Several degrees of modulation depth are shown in Figure 3. 3-A corresponds to complete, or 100 pc modulation, 3-B to incomplete (approximately 50 pc) modulation, and 3-C to over-modulation (somewhat greater than 100 pc).

Note from these voltage or current curves that the maximum and minimum modulated amplitudes are equal respectively to twice the unmodulated value and zero for 100 pc modulation, less than twice carrier and higher than zero for incomplete modulation, and greater than twice carrier for overmodulation.

Observe also that by-products of overmodulation are the cut-off periods along the zero line.

In a completely-modulated transmitter, the instantaneous antenna current or voltage is raised to twice its normal value by positive modulation peaks and decreased to zero by negative modulation peaks.

The antenna resistance remains constant as long as the carrier frequency is not shifted; so the power in the modulated wave is directly proportional to the square of the modulated carrier voltage or current: ($P = E2/R = I2R$).

In any carrier that is modulated 100 pc by the amplitude method, the instantaneous peak power is therefore four times the unmodulated carrier power. The completely-modulated amplifier or oscillator must be capable of supplying this increased peak power output.

## DETECTOR ACTION

The audio-frequency voltage and power delivered by the detector in a radio receiver is proportional to the amplitude of the modulating voltage. This voltage is equivalent in magnitude and frequency to the modulation envelope.

In order to obtain the largest undistorted detector output for a given carrier, the largest permissible a.f. voltage must be employed in the modulation process—which is another way of stating that the highest permissible values of modulation depth, modulation factor, or modulation percentage give the highest undistorted detector output levels.

100 pc modulation is the maximum permissible depth which may be applied to any carrier wave, since this percentage allows the carrier amplitude to be swung between zero and twice its normal value, the maximum safe limits.

Higher percentages of modulation have already been shown to introduce cut-off periods (Figure 3-C), which because of the high damping they introduce, cause broad tuning.

Distortion, resulting from loss of the negative modulating voltage peaks and deviation of the carrier frequency during modulation, are also by-products of excessive modulation depth.

Complete modulation of a transmitter reduces heterodyne interference at distant points, improves the signal strength (and signal-to-noise ratio) in receivers in the service area, and affords a better increase in the station's service area than might be gained by reasonable increases in the transmitter carrier power.

An audio increase of only 3 db, for example, is equivalent to *doubling* the carrier power. 100 pc modulation

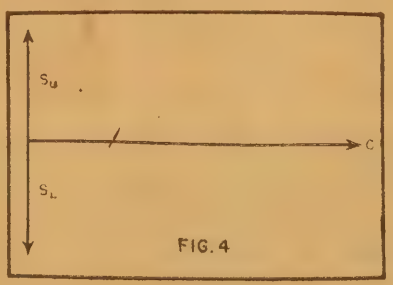


FIG. 4

makes the most effective use of a carrier in the most economical manner.

One of the by-products of normal amplitude modulation is the heterodyne effect between the a.f. and r.f. components.

As is the case when any two frequencies are combined, two beat notes are set up by the modulation process, due to interaction of carrier and modulating voltages. One of these beats is equal to the sum of the two frequencies, and the other to their difference.

Consequently, two radio frequencies other than the transmitter or oscillator carrier are generated by the modulation process; one being equal to the carrier plus the modulating frequency—the other to the carrier minus the modulating frequency.

These are the well-known *side frequencies*, lying one above and one below the carrier, which set the limits of the *side bands*. The intelligence is conveyed by these side bands.

## PHASE RELATIONS

The initial phases of carrier, upper side frequency, and lower side frequency are O, —90, and +90 degrees. These phase relationships are represented vectorially in Figure 4, where the components are either peak or effective carrier voltage and side-frequency voltages.

Su and Sl are the upper and lower side-frequency voltages, respectively, while C is the carrier voltage. With respect to the carrier vector, C. Su rotates counter-clockwise, while Sl rotates clockwise.

At maximum modulated amplitude, the side-frequency vectors are in phase with the carrier vector; at minimum modulated amplitude, 180° out of phase.

With respect to the magnitudes of the side-frequency voltages or currents, the modulation percentage is:

$$(3) \qquad \% \text{ Modulation} = \frac{S_u + S_L}{C} 100$$

The channel width of an amplitude-modulated emission is fixed by the separation of the upper and lower side frequencies and is the total width of the side bands so delineated. The channel width is thus twice the frequency of the modulating voltage.

When the latter contains several frequencies, as in speech or music modulation, the highest modulating frequency in the complex group determines the maximum side-band width.

Figure 5 shows various circuits for amplitude modulation. 5-A and 5-B are arranged for plate modulation of the r.f. tube; 5-C for grid-bias modulation; 5-D, cathode modulation; and 5-E, suppressor modulation.

Plate modulation may be *constant current* or *constant voltage* in type. In the former case, the modulator delivers audio-frequency power to the r.f. tube. In the constant voltage system, the modulator may be considered equivalent to an audio-

**(Continued on Page 95)**

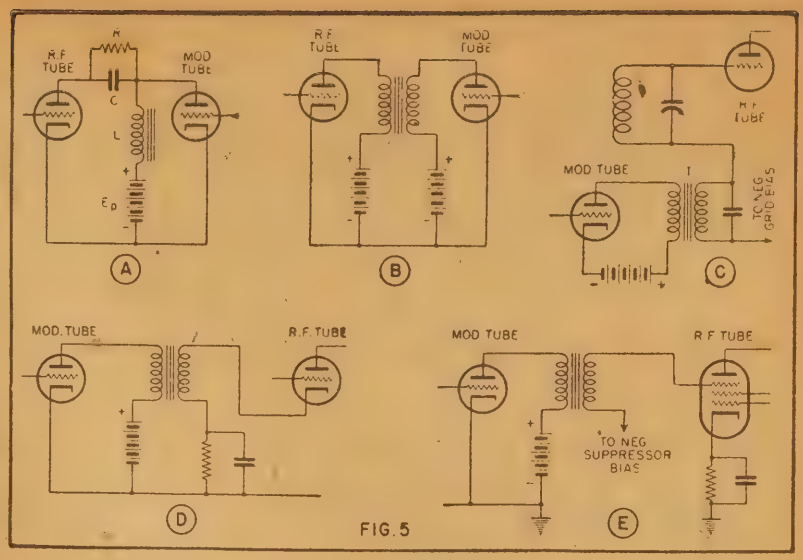
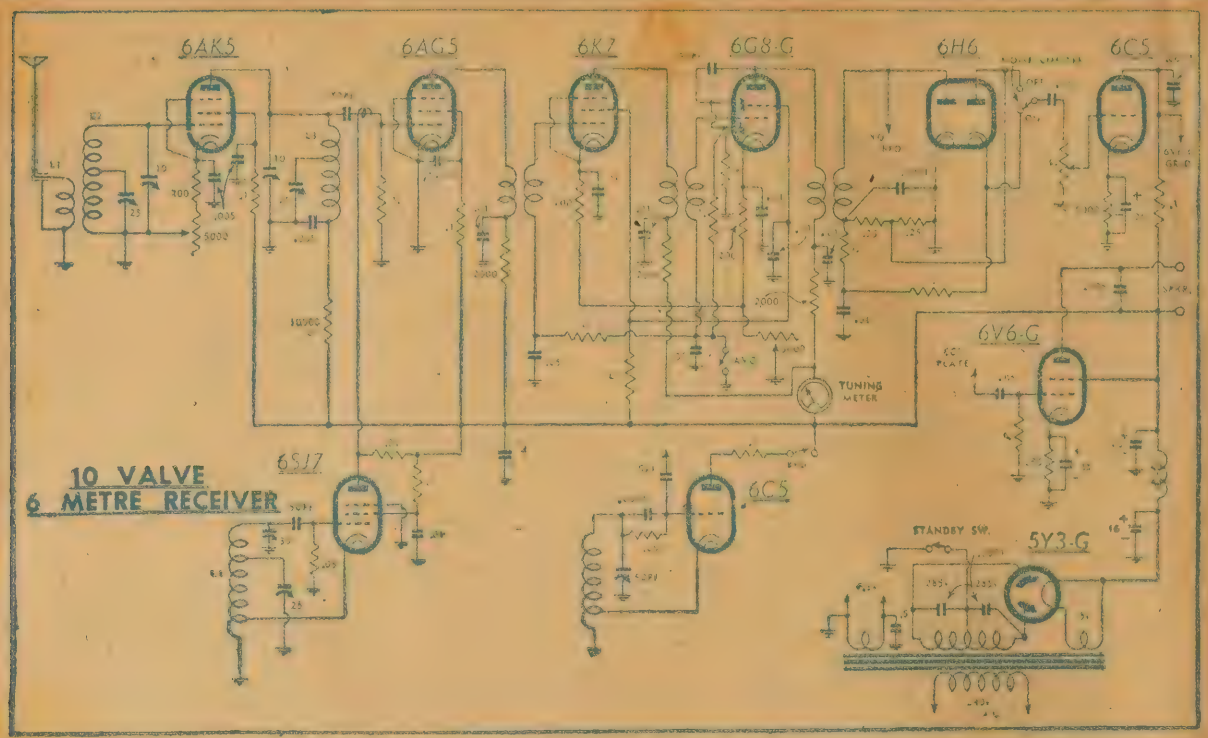


FIG. 5




This is a standard circuit for a 50mc. superhet using a 1.9 mc IF channel. From it many circuit pointers may be extracted. It is not critical as to valve types, and all those mentioned (except the EF50) have been used in it from time to time with alterations to bias and decoupling resistors as appropriate. Valve data sheets will guide you on these matters. The RF and mixer circuits could be ganged and the oscillator separately tuned if this will simplify construction.

# RECEIVING ON VHF BANDS

**No radio journal today can afford to ignore the techniques used on the Very High Frequencies for reception and transmission. Not only does the imminent impact of television give point to them, but they must be considered for their own interest. In the next few issues we intend to cover some practical material on VHF reception, using the amateur bands at 50 and 144 Mc for our examples. It is not hard to build simple equipment to give excellent results on these bands, and which will be representative of general practice used in this part of the spectrum.**

by John Moyle

TO introduce the subject, this article will deal with the matter in simple terms, illustrated with circuits and circuit values, which will allow them to be built up as useful equipment.

Firstly, we should forget the idea that the VHF region is shrouded in complication and mystery, only to be penetrated by super brains and special study. Basically, it uses exactly the same electronic principles found elsewhere in radio, but which we encounter in a more familiar guise.

## SAME ESSENTIAL CIRCUIT

For instance, most experimenters recognise a broadcast tuning coil and tuning gang. Their ideas are conditioned to many turns of wire on large and small formers, and condensers having many plates in several sections.

On 50 mc, however, which corresponds to a wavelength of about six metres, we find exactly the same essential coils and condensers, but scaled down in size.

Our tuning coils might have only six turns of wire, space-wound about 5-8in in diameter, and our variable condensers may be five, tiny, little plates in each section. But they work in the same way as their counterparts on the broadcast and standard short wave bands.

In broadcast and short wave sets, we can use standard types of valves such as the 6SK7, 6K8, and so on. For VHF sets, these valves are not very efficient, because, among other things, the leads inside the valves themselves, are too long — long enough to represent a big portion of the inductance required for the tuning coils.

As a result, miniature valves have been specially produced for work on VHF, and as many of them are equally suitable for lower frequencies, they are replacing the bigger valves in almost all applications.

As we go higher in frequency, even these valves are too big, and we use only selected types if we want good results. Eventually, frequencies are reached in which only a few special valves are of much use. But these are above the 144 mc band we have selected as the highest for our discussions.

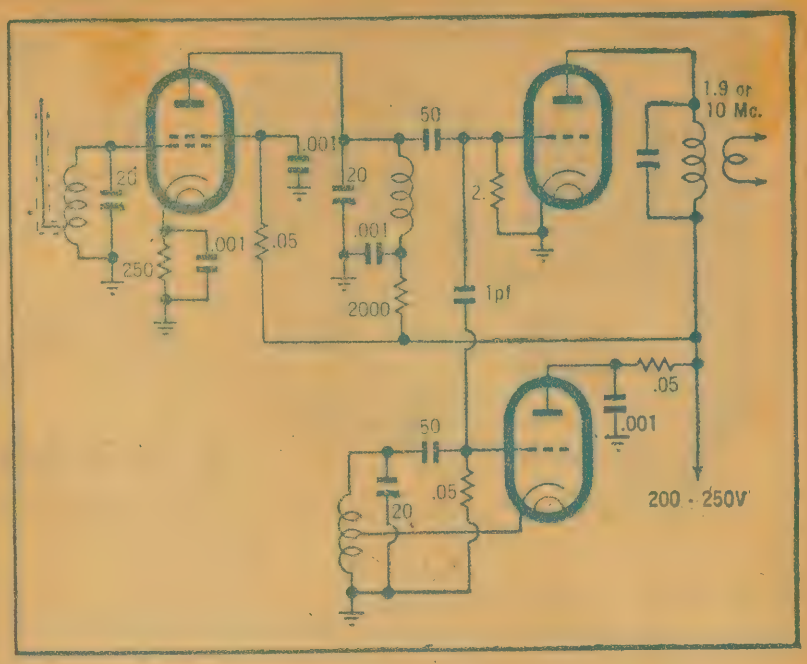
## A COMPARISON

The main point made here is that, although the components will, in general, be scaled down in size and magnitude on the VHF, they are essentially similar to those we have been using. On 144 mc, we are introduced to some new ideas of doing things,

but none of these is difficult. When we have become used to working with tiny coils and other components, we can find our way around circuits and chassis just as easily as we do on the lower frequencies.

Of the two bands, 50 mc is the one requiring the last change in approach, and, although special VHF components are best, we can get away reasonably well with almost anything. At 144 mc we are approaching the regions where the extremely small components needed call for a change in approach, such as the use of parallel tuned lines to take the place of coils so tiny they almost cease to exist. This makes the contrast and comparison between the two bands extremely interesting, and a grand field for experiment.

At this stage, it might be well to review the reasons why different types of valves, condensers, &c. are required for VHF as against the broadcast band. In so doing, we will, at the same time, touch on many important points of design associated with them all, leading to a discussion on actual circuits.




Here is a typical circuit using a pentode RF stage and triode mixer and oscillator. Its main purpose is to illustrate how you might use some valves on hand. For instance on 50mc, a 954 and two 955's would be quite useful, with a 6AG5 pentode it would be fine. It would also work on 144mc with appropriate coils.

## VALVES

We have already mentioned one reason why large valves are objectionable — the leads inside the valves connecting to the elements are so long as to be comparable with the amount of wire in the tuning coils. They are, in truth, small inductances, which prevent us from effectively earthing the cathodes, for instance.

This point is so important, particularly on frequencies above 100 mc, that many valves have several separate leads connected to the cathode, so that the impedance to ground can be reduced by the use of parallel paths. This is done even though the valves are miniature types with quite tiny lengths of leads inside the glass.

A further and possibly more important use of the multiple cathode connections is to allow plate and grid circuits to be bypassed to the cathode through different paths, thus avoiding unwanted coupling between them which occurs in some degree with a single cathode terminal.

A shield plate is often placed across the valve socket, with the plate circuit and one cathode connection on one side, and the grid circuit and the other cathode connection on the other.

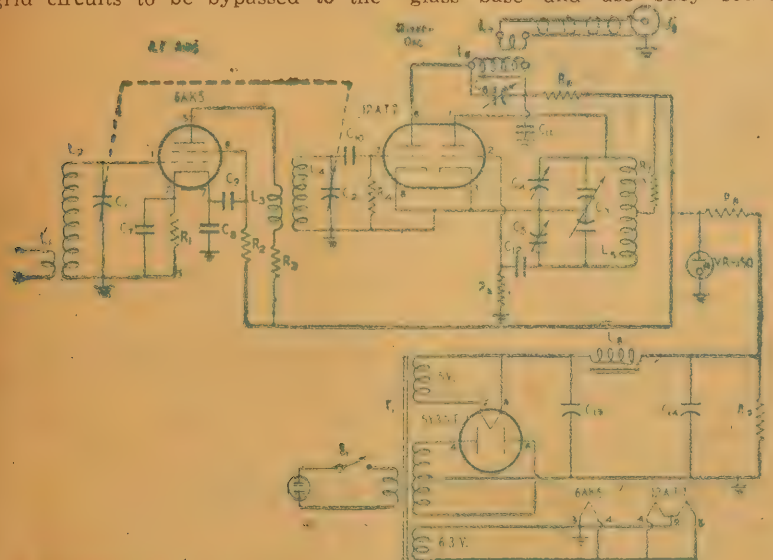
Effective lead length is also reduced by abandoning the normal valve socket. Miniature valves have pins which run directly through the glass base and use baby sockets, which add little to the total length.

Naturally, extremely short leads are most important on 144 mc, although they should not be overlooked on 50 mc as well.

Miniature valves have small elements spaced to reduce internal capacitances to a minimum. Together, with stray capacitance in wiring, &c, these often form the only tuning for the coils or inductances, particularly on 144 mc, and must be carefully watched if reasonable L/C circuits are to be achieved.

In selecting valve types for the RF end of 50 and 144 mc receivers—and they are of course the all-important ends—we have a pretty problem to extract from many circuit features involving noise level and circuit gain—the familiar signal to noise ratio.

On the one hand we have some excellent VHF pentodes which give a high gain per stage for a given noise level, the latter due to electron movements within the valve. On the other we have similarly suitable triodes which give somewhat lower gain but a very much lower internal noise level.

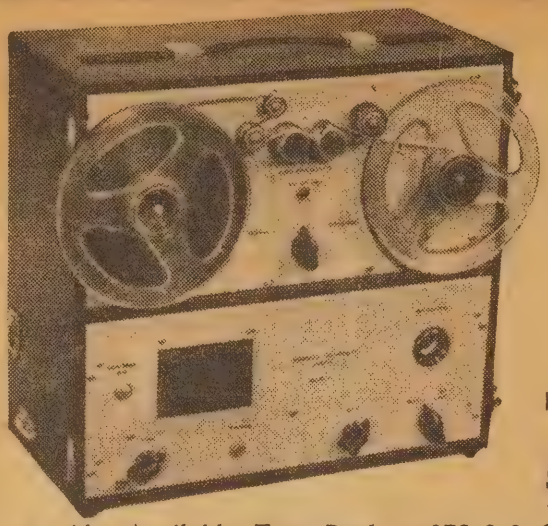



This circuit taken from the ARRL handbook illustrates an excellent combination of valves and circuitry for either 50 or 144mc. High tension should not be over 150 volts, the limit for the 6AK5 as used here. Note the double bypassing on the 6AK5 cathode. This valve should carry a small shield dividing plate and grid circuits, also connected to the centre socket shield. For values see end of this article. Power could be taken from another receiver.

## COSMIC NOISE

Added to the valve's own generated noise, we have the noise generated in the aerial circuit itself, and various other noises, such as those due to cosmic radiation, which add to it in our final result. This external noise is much higher at 50 mc than it is at 144 mc, and, according to some estimates, peaks at around 60 mc.

Thus, while we can always build quieter RF ends usng suitably connected triodes than with pentodes, we cannot always make use of this inherently lower noise. At 50 mc it is easier and simpler to obtain good gain from an RF amplifier using a



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pentode than a triode, and the noise from either is so much lower than the noises we find in the input circuit that it frequently swamps out the difference.

At 144 mc, however, externally generated noises have dropped to such a point that it is worthwhile using triode circuits to improve our signal to noise ratio, and for this reason, engineers have spent much time designing low noise triode circuits, such as the cascode. Even so, in some noisy locations there might be little difference between the two approaches, and there are plenty of good receivers on 144 mc, which use a pentode RF amplifier. In general, however, triodes are best higher than 100 mc, and as we go into the regions above 144 mc, establish a clear lead.

## SUITABLE TYPES

Actual valve types for RF amplifiers on 50 mc can be 6AK5, 6AG5, 6BA6, in that order, and of the larger-based valves the EF50 and RL7 are excellent. Even the 9002 can be used effectively, also the Acorns, but these are below the first-named in performance.

For mixers, the valves mentioned above are all usable in similar order of preference. Triode mixers could be the 6J6 and 12AT7 (with the second section used as the oscillator), 6C4, 6AK5 as a triode (a very good mixer) and the 9003 and 955.

Almost any of the Acorn and miniature valves are suitable as oscillators, either as triodes or pentodes. As the injection voltage needed is small, we can concentrate on frequency stability rather than anything else.

On 144 mc much the same story is true as regards the pentodes. In triode circuits, the cascode is so popular and successful that it can be regarded as more or less standard, and we refer you to the later details on the circuit.

Perhaps the most important components other than valves are the bypass condensers used on these bands. Here again we are up against the fact that all condensers have some inductance which makes them less effective, and often considerable further inductance in their connecting leads.

On 50 mc, it is reasonably safe to use miniature mica condensers, but on 144mc, the latest types of special VHF condensers are so much better that they should be considered essential.

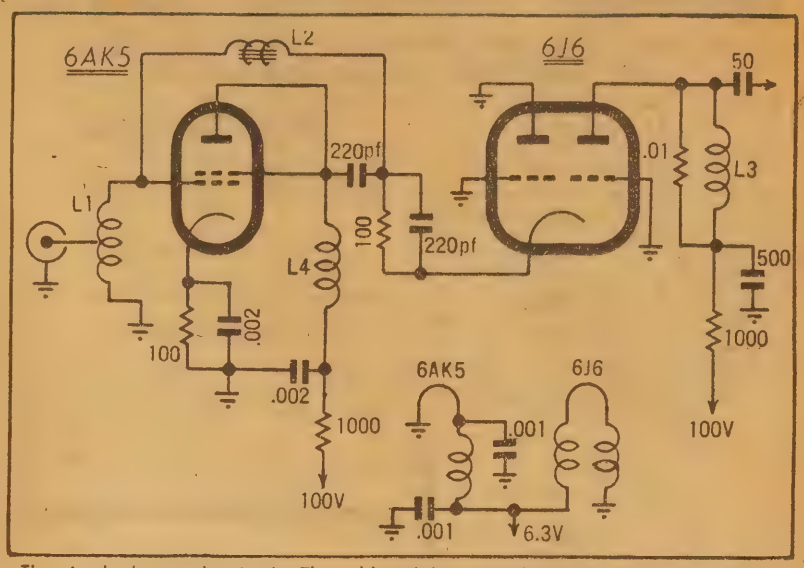
For bypassing cathode, screen, and plate circuits, we can use multiple "stick" condensers, either singly or in multiple types. Some of these have threaded ends for bolting upright on the chassis, allowing very short leads to be obtained by careful placement. Their values tend to vary a good deal, but are rarely less than the marked figure, and that is the important point.

## BYPASS AND COUPLING

For coupling condensers we have other "button" types, specially made for the job, which again have extremely low inductance, particularly if careful layout reduces lead length to a minimum.

A further type, known as the "micadisc," is a combination feed-through insulator and bypass con-

# THE STANDARD CASCODE CIRCUIT




The standard cascode circuit. The odd coil between the 6AK5 grid and plate circuits neutralizes this valve for minimum noise level. This circuit will be more fully detailed in a later issue.

denser, very useful for plate bypassing where appropriate. It is a wise plan to obtain a manufacturer's specification sheet for these new miniature condensers, which enable you to specify the exact type number when laying out your tuner.

Use these baby condensers on either band if you can, and always on 144 mc.

Tuning coils ideally should be made of silvered wire, but this is hard to get, and tinned copper, or better still bare copper, is generally used. Where possible they should be mounted on ceramic or polystyrene mounts, but again ordinary terminal mounting strips can be used without seriously affecting results. Straight point-to-point mounting is best, but as rigidity is often most important, it should receive priority in construction, together with the always important short leads.

Most coils are best wound with 16-gauge wire, at least for 144 mc, and all oscillator coils. On 50 mc, 18-gauge will often do, but never lighter than this.

Because of the variations in stray circuit capacitances and lead inductances, small variations from published coil data will nearly always occur, generally compensated for by increasing or decreasing turn spacing. Changes in wire gauge will generally make a difference. Coils should always be space wound to about one coil diameter unless otherwise specified.

Obviously the need for short leads means that VHF receivers compress many components in a small space. This is another thing one must get used to in building, and a light, small-bitted iron such as the "Scope" is a great help, together with fine-gauge, cored solder. It is quite practicable, and desirable, to draw out the layout on paper before mounting and wiring. It is amazing what care and ingenuity can do in cutting down those lead lengths, and fitting everything neatly into place. It is, in fact, a special fascination of VHF construction.

Most experimental chassis are made of aluminium because it is so easy to work, and electrically quite good. Unfortunately, earth connec-

★

A typical mixer oscillator circuit using the popular and not too hard to get 6J6. It could be used quite usefully as a single valve converter for very easy reception on either band, but normally an RF stage is well worth while sooner or later, if only because of its isolating effect from the aerial circuit, and to provide a strong signal for good mixer action.

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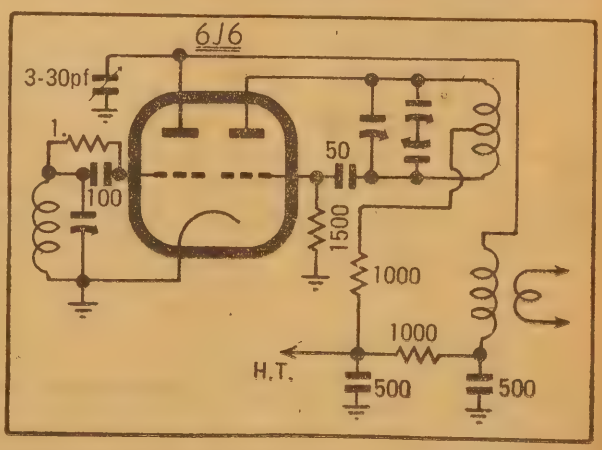

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tions cannot be soldered to it, and great care should be taken to earth leads to solder lugs tightened under nuts and bolts, with a lock washer biting into the metal. Aluminium is not very rigid, and mounting brackets, &c., should be of heavy gauge if it is used.

The ideal material would be silver-plated copper or brass, because of the high conductivity of the silver. The average man can more easily obtain plain copper or brass, which are probably the most useful, but steel is quite OK. Always solder earthed leads to the chassis where possible.

## COMPLETE SETS

Although receiving equipment invariably uses the superheterodyne circuit, complete receivers for VHF are by no means essential. In fact most reception is done with converters which feed into standard short-wave receivers at frequencies varying from 7 to 30 mc, according to design. The effect is to create a double-conversion circuit through which the normal receiver selectivity is available when tuning VHF stations.

Any other facilities of the receiver can also be used, such as the BFO, AVC and perhaps noise limiter—almost a "must" on VHF where motor car ignition noise is vicious.

Double-conversion is a good thing because converting directly to the standard 455kc IF brings many difficulties of oscillator pulling, possible instability, &c., due to the very small difference between signal and oscillator tuning. Double-spotting is also present because the VHF tuning circuits have insufficient selectivity to stop it.

The actual frequency at which the converter feeds into the set isn't critical, but should be one which doesn't allow a strong station to be picked up by the receiver's input circuit.

There are two general techniques for tuners on VHF—the "narrow band" and the "wide band."

The "narrow band" we call the standard method of using tuned circuits in each stage, either ganged, or individually peaked, or both. The gain will fall away quite rapidly should any one of the circuits become out of line, the amount depending on whether a high or a low IF is concerned.

The "wide-band" technique consists in using circuits which are deliberately damped, either by resistors across the external circuits or by using valve characteristics, to mention two chief damping factors. This drastically reduces their selectivity by reducing the circuit Q so that the response curve has no sharp peak, but rather a flat, broad response. The same principle is often used to obtain wide band tuners even on the broadcast band, when these are desired.

## HIGH GM VALVES

Naturally, the gain of such circuits will not be nearly as high as for normal tuned circuits, but the loss is made up for by using valves with a very high Gm. The net effect is to obtain appreciable amplification with fairly even gain over a bandwidth of several megacycles. In the case of 50 and 144 mc bands, this is enough to cater for the bands 50-54 and 144-148 mc, with very little variation in gain.


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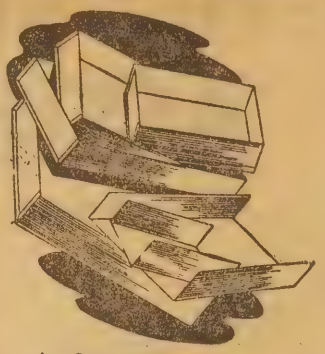

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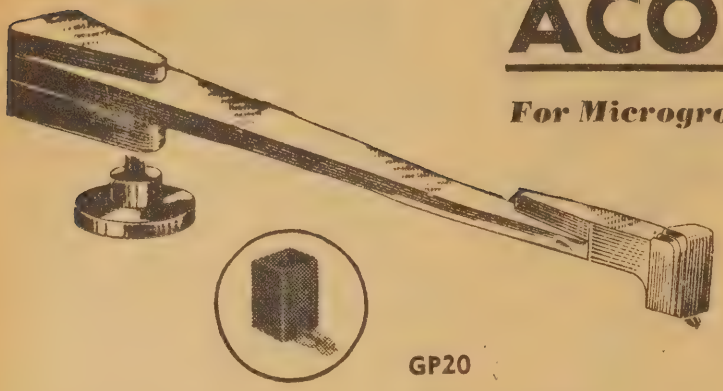

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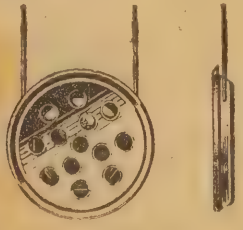

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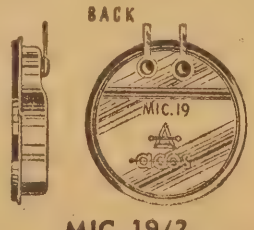


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Such circuits are extremely useful when double conversion is used. The wide band-width allows us to use a fixed oscillator on the VHF, and to do our tuning by using the receiver's own tuning dial. In effect we are tuning the first intermediate rather than the signal frequency.

A common practice for both bands is to arrange things so that 50 and 144 mc are tuned with the receiver dial reading 10 mc. The 4 mc band-width is then covered for each band by tuning to 14 mc.

With a little extra complication, such converters can employ crystal controlled local oscillators with lower drift, higher stability, and a clean note for CW reception. The crystal used is generally in the range of about 6-8 megs and is followed by harmonic amplifiers multiplying to the desired frequency.

## CONVERTERS AND RECEIVERS

Such converters are particularly valuable on 144 mc, where stability is hardest to obtain, and are often used even on 50 mc. As there is no adjustment required to such a converter, it may be housed anywhere at all, and connected to the receiver with a suitable cable. An example of this, probably the de-luxe circuit of the moment, is the crystal controlled, cascode tuner.

Straight, single-conversion receivers are quite practicable, however, if high selectivity isn't essential. A suitable IF for 50 mc is the standard 1.9 mc using two stages, and on 144 mc, about 10 mc using three stages. The writer has used sets of both types, and finds them quite good providing the stations do not crowd too closely. On 144 mc there are still modulated oscillator transmitters to be heard, and the double conversion sets are generally too sharp to receive these satisfactorily.

In an emergency, a lead is connected through a small capacitance to the last IF grid of the receivers, and fed to a standard short-wave set, tuned in the one case to 1.9 mc, and in the other to 9.8 mc, which is the exact IF used. This scheme provides ample coupling to obtain double-conversion, and make use of the SW set's extra selectivity. But then, of course, this latter procedure might just as well have been followed in the first place! Individual circumstances naturally will decide such matters.

## DOUBLE CONVERSION

Generally speaking, the double conversion will give a lower overall noise level. Noise passed through a receiver is directly proportional to the bandwith. An IF of 9.8 mc, therefore, will accommodate much more noise than will a double conversion job with a sharp, 465 kc channel, and this is quite important in listening to weak signals. It is a point often forgotten when assessing the relative noise generated by different types of tuning circuits and valve types.

With this article we reprint the circuit of a standard receiver for 50 mc, using two stages of IF at 1.9 mc, a tunable oscillator, and a pentode RF stage. It is quite easy to make, and uses many standard parts and valves lying on most experimenters' shelves.

It illustrates quite clearly the similarity in circuitry to that of an ordinary SW set, even to the band-spread taps on the tuning coils. The gang was a baby type with five small plates per section, taken from disposals equipment. To be safe, three-plate, hand trimmers were fitted to make sure all circuits could be peaked, as exact tap positioning is a bit fiddly to achieve. The tracking, however, is almost perfect.

The 6AK5 is sometimes hard to stabilise because of its high gain, and for this reason, a 6AG5 may be used instead, reducing the plate decoupling resistor to 2000 ohms, and the screen resistor to .05 meg. "On the air" it is doubtful whether much improvement could be made on this circuit. The first IF could be replaced by a coupling coil with a low impedance secondary for feeding a SW set tuned to 1.9 megs (or other suitable IF), and the rest of the circuit omitted. The tuning end then becomes a converter circuit if you wish.

This receiver is still used, and participated in record-breaking communication in the immediate postwar years over distances exceeding 200 miles.

The built-in noise limiter is quite important, and virtually wipes pulse interference such as car ignition noise.

The EF50 or RL7 could be used as RF amplifier and mixer with good results.

Another circuit shows the tuning end re-drawn to include a triode oscillator which is often used, and yet another shows a circuit for a triode mixer-oscillator using a modern twin-triode. This circuit gives somewhat lower noise level, and saves a valve. It is in the aerial and RF grid circuit, however, that most of the set's signal/noise ratio is decided. As long as the converter valve receives a reasonable signal there is little difference between the pentode and the triode mixers.

## THE CASCODE

A further circuit illustrates the cascode circuit. It is a broad-band type, the circuits being damped by the valve constants and by the aerial connection.

The first valve, here a 6AK5 triode connected, allows a reasonably high impedance circuit to be included for aerial coupling, and being a triode, contributes little noise in this circuit. It feeds a second triode connected as a ground-grid amplifier, again to reduce noise level and provide good gain. The cathode circuit impedance of the second triode is too low for efficient direct aerial connection. It is so low that it cancels nearly all the gain of the first valve, which is therefore functioning as a combined coupling and impedance matching device.

The second valve feeds a standard type of triode mixer-oscillator, and the latter can be crystal locked if desired. This circuit will be dealt with more fully in a later issue. It is extensively used on 144 mc and frequently on 50 mc.

There are numerous other circuits which can be built up. Some of them feature push-pull triode RF amplifiers and mixers, again designed to achieve the best signal-noise ratio. Space does not allow us to describe them all, and those we have included are quite representative of the best accepted technique at present.

## COIL DATA

As has been pointed out, exact coil data is difficult to specify, because of varying circuit layouts, minimum and maximum capacitances of tuning condensers, &c. Particularly at 144 Mc, these can make a big difference, and only where a definite layout and components can be specified, as in a constructional article, can one be confident.

However, in the big circuit of the 50 Mc set, L1 had 4 turns, L2 7 turns tapped at 3½, L3 6 turns tapped at 3, and L5 5 turns tapped at 3 turns. All of ½in diameter and wound with 16 gauge wire spaced about one diameter. These values should be fairly right for most cases as long as the total C across the circuits isn't too high. For oscillator stability, turns could be reduced and capacitance increased for L5. We later changed the valve to a 9003.

## COILS FOR 144 MC

For 144 Mc, try coils of 4 turns for L2, 3 for L3 and 2 for L4, using 16 gauge and 3-8in diameter. If co-ax. is used at the input, it is tapped to L2.

These coils should be about right for the pentode-triode converter on page 37. For the 144 Mc cascode, L1 has 5 turns 3-8 diameter tapped at 3 turns from earth, L2 5 turns of 24 gauge close wound on a 5-16th former, L3 has 4 turns 3-8 diameter and L4 3 turns 3-8 diameter. The tuned coils are of 16 gauge spaced one diameter.

The 6J6 mixer oscillator circuit uses L1 of 4 turns 3-8 diameter with a 72 ohm aerial tapped halfway. It need not be tuned. The oscillator coil has 3 turns 3-8 diameter and is tuned by a split-stator condenser from an IFF set. C1 and C2 are small 1½-7 pf trimmers. Use coils similar to those already given for 50 Mc.

The ARRL circuit can use similar coils again. C1, C2 are 10 pf, C3 can be an IFF condenser, C4, C5 3-30 pf trimmers, C7, 8, 9 .001, C10, 12 100 pf C11 .001, R1 150 ohms, R2, 5, 6, 7 10,000 ohms, R2 2200 ohms, R4 1 meg, R8 5000 ohms, and R9 25,000 ohms.

## EASILY CHANGED

If the coils are air spaced, as they should be, and mounted on terminal strips, they can be changed very easily while adjusting for the exact number of turns. In this connection a grid dip oscillator is extremely valuable. While it is possible to find the band by "using your head" when you know strong stations are on the air nearby, you will probably save much time in finding your first signal if you can trot your tuner along to a friend who has a "dipper," or, better still, by making one yourself. An absorption meter is quite handy for working on the oscillator coil, and once you have it tuned into the band, a strong signal should come though even with the other circuits not properly peaked. Once you have a signal, the rest is straight going.

Once again, don't forget the great importance of rigidity. Rock-like mounting of the oscillator section if it is tuned will make all the difference between smooth operating and a jumpy nuisance! Similarly, sloppy dials are out!

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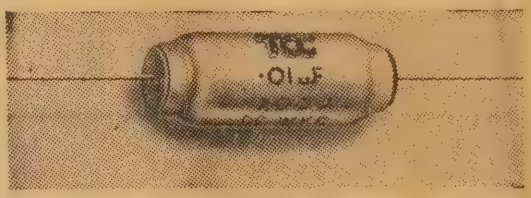

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# A COURSE IN TELEVISION

## PART 44 — TELEVISION FROM FILMS

**It would appear that films, in one form or another, will always be to television what discs and tapes are to sound broadcasting—a means of sustaining the programme at times when it is either uneconomical or impractical to air live shows. This article explains some of the problems, technical and otherwise, which are involved in televising film material.**

FILM material may be subdivided, for the sake of clarity, into two main classes:

(1). Films which are produced purely for television purposes — TV shows, newsreels, reports, commercials, effects and so on.

(2). Standard feature films intended originally for exhibition in theatres but now in demand for TV programs.

For those concerned with programing and policy, the relationship of these feature films to television is a vexed and complex problem. In fact, it looms today as the outstanding problem in the entertainment world.

To date, feature films have represented the most prolific and lavish means of public entertainment and their production costs are enormous. These are recouped, however, by exhibiting the films for perhaps many years before audiences throughout the world and the audience automatically pays for them at the box office.

If the same films were to be exhibited freely on large TV networks, their total cost would have to be recovered during relatively few showings. And, very obviously, the total cost per showing to television promoters would be enormous.

### SPECIAL PAYMENT

Assuming that the figure would be far too high for an advertising sponsor, the only alternative would appear to be a system whereby television viewers could watch such a program only after the payment of a suitable fee. In other words, the film would simply be viewed and payed for by individual patrons in their own homes rather than in the theatre.

Such a system has actually been tried out in America. The essential idea is to radiate the program without the usual synchronising pulses so that ordinary receivers will not lock into the picture. However, by dialling a certain number, the necessary synchronising pulses are piped into the home via the telephone circuit and fed ultimately to the receiver.

The appropriate charge for viewing the show is then added to the phone bill or made the subject of a separate account.

Just how far this idea is likely to go, or how it will merge with "free" programs remains to be seen.

Some have suggested that, ultimately, all major films will be made primarily for television; that they will be released on a patron-payment basis and viewed, for the most part, in the home.

Contrariwise, others maintain that there is a natural urge to dress up and go out and that, because of its very informality, television will never completely supplant the theatre.

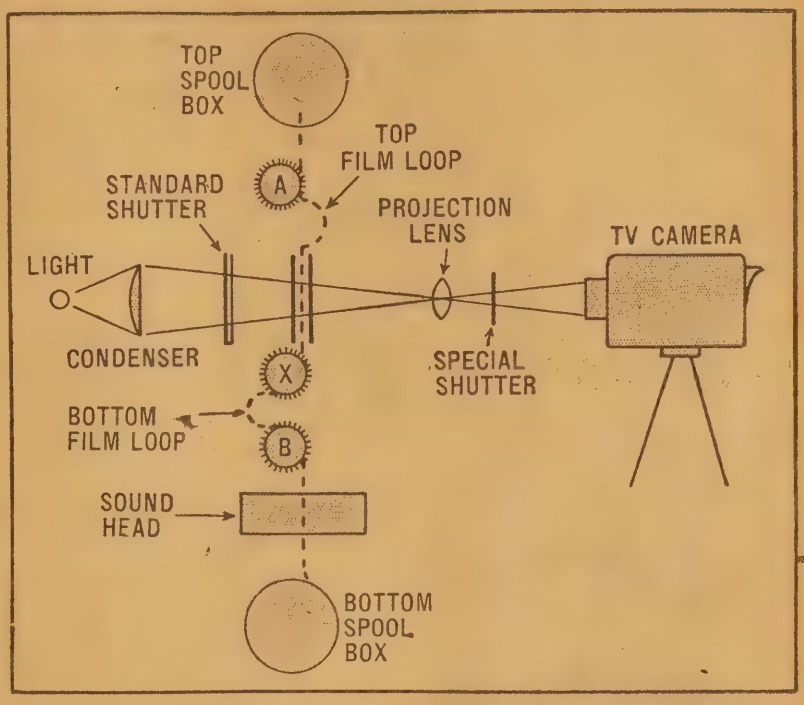


Figure 1. A typical set-up for televising a film using a standard intermittent projector and a 50-frame TV camera. "A" and "B" are feed sprockets, "X" the intermittent sprocket.

Rather, they contend, will large-screen television be used to exhibit selected programs and current fixtures throughout large theatre circuits, the public still paying for the privelege at the box office. The interest being taken currently by the major film companies in theatre television is significant in this respect.

In the meantime, whatever the ultimate answer to this problem, the policy has been to televise only the old feature films which are of little further value for exhibition in theatres. Even some of the early Australian films are finding their way overseas for exhibition on home television screens.

Apart from full-length films, there is a good deal of scope for "shorts" — educational, travelogues, musicals, commercials and current newsreels. Cartoons have an obvious general appeal but, once again, theatre interests are not keen to kill their current and costly cartoons by allowing them to be televised.

Whole books have been written on this subject but enough has been said for the reader to grasp the implications of it.

Technically, a good theatre film does not necessarily make a good TV feature. Viewing conditions in a theatre, with the large screen and low ambient light, allow free use of distant and landscape shots. These are likely to lose their value in the hazards of a TV circuit, and the close-up, angle-shot approach is much more reliable.

### TV REQUIREMENTS

Then again, involved story plots which are acceptable to a theatre audience, may fail to hold the much more casual television audience. If the viewer loses interest in a program at any stage, he simply tunes to another station.

Films made for TV display are always produced with such requirements in mind.

Quite apart from regular "movie" features, films are the obvious medium for "canning" live shows for subsequent replay or release through other television networks.

In some cases, the film record may be photographed direct from the

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| PF163 | 200, 230 ,240 | 325 | 125 | 6.3VCT/2.5A, 6.3V/2A, 5V/2A | 86/10 |
| PF181 | 200, 230, 240 | 385 | 125 | 6.3VCT/3A, 6.3V/3A, 5V/2A | 95/8 |
| PF174 | 200, 230, 240 | 285 | 150 | 6.3VCT/2A, 6.3V/2A, 5V/2A | 89/8 |
| PF142 | 200, 230, 240 | 325 | 150 | 6.3VCT/2A, 6.3V/2A, 5V/3A | 96/7 |
| PF175 | 200, 230, 240 | 385 | 150 | 6.3VCT/2A, 6.3V/2A, 5V/3A | 111/11 |
| PF173 | 200, 230, 240 | 425 | 175 | 6.3VCT/3A, 6.3V/2A, 5V/3A | 173/3 |
| PF140 | 200, 230, 240 | 385 | 200 | 6.3VCT/3A, 6.3V/3A, 5V/3A | 162/2 |
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| PF179 | 200,230, 240 | 475 | 225 | 6.3VCT/4A, 6.3V/2A, 5V/3A | 183/1 |
| PF107 | 230, 240 | 585 | 250 | 6.3V/3A, 6.3V/2.5A, 5V/3A | 224/10 |
| PF176 | 200, 230, 240, 260 | 1250 | 300 | 6V/.3 | 449/9 |
| PF177 | 200, 230, 240, 260 | 1830, 1100 | 300 | 6V/.3A | Price on request |

## VIBRATOR AND A.C. POWER TRANSFORMERS

| | | | | | |
|---|---|---|---|---|---|
| PF182 | 240AC 12V1B | 200 | 40 | 12.6V/1A | 53/10 |
| PF122 | 240AC 6V1B | 220 | 140 | 6.3V/2A | 54/- |
| PF125 | 240AC 6V1B | 250 | 60 | 6.3V/2A | 63/- |
| PF126 | 240AC 12V1B | 250 | 60 | 12.6VCT/1A | 63/- |
| PF119 | 240AC 6V1B | 325 | 125 | 6.3V/4A | 89/10 |
| PF146 | 200, 230, 240 AC, 12, V1B | 325 | 150 | 12.6VCT/2.5A | 105/9 |

## VIBRATOR TRANSFORMERS

| CODE NR | PRIM. VOLTS | DC OUTPUT VOLTS | DC OUTPUT mA | BUFFER Full Sec. | | RETAIL PRICE |
|---|---|---|---|---|---|---|
| VT100 | 32 | 200 | 40 | .005 | | 44/6 |
| VT101 | 6 | 90 | 15 | .008 | | 34/10 |
| VT102 | 6 | 150 | 25 | .005 | | 40/9 |
| VT103 | 6 | 200 | 50 | .005 | | 42/11 |
| VT104 | 6 | 250 | 60 | .005 | | 43/11 |
| VT105 | 12 | 250 | 60 | .005 | | 45/6 |
| VT106 | 6 | 300 | 75 | .008 | | 72/7 |
| VT107 | 6 | 250 | 60 | .005 | Low Radiation | 48/1 |
| VT108 | 12 | 90 | 15 | .008 | | 36/3 |
| VT109 | 24 | 90 | 15 | .008 | | 38/4 |
| VT110 | 12 | 150 | 25 | .005 | | 42/11 |
| VT111 | 24 | 150 | 25 | 005 | | 47/- |
| VT112 | 12 | 200 | 50 | .005 | | 45/- |
| VT113 | 24 | 200 | 50 | .005 | | 45/- |
| VT114 | 12 | 300 | 75 | .008 | | 78/2 |
| VT115 | 24 | 300 | 75 | .008 | | 79/- |
| VT116 | 24 | 250 | 60 | .005 | | 50/1 |
| VT117 | 12 | 250 | 60 | .009 | Low Radiation | 48/6 |
| VT119 | 32 | 150 | 25 | 005 | | 40/8 |
| VT121 | 6 | 180 | 30 | .005 | | 45/- |
| VT122 | 6 | 400 | 50 | .005 | | 73/4 |
| VT123 | 12 | 320 | 125 | .005 | | 94/5 |
| VT124 | 32 | 250 | 60 | .005 | | 49/1 |
| VT127 | 6 | 200 | 50 | .005 | Low Radiation | 45/- |
| VT128 | 12 | 250 | 60 | .005 | Low Radiation | 53/1 |
| VT146 | 6 or 12 | 240AC | 50W | 1MFD. | For emergency light, etc. | 64/2 |

## POWER CHOKES

| CODE No. | IND. HY. | DC RES | DC mA | RETAIL PRICE |
|---|---|---|---|---|
| CF100 | 50 | 1900 | 10 | 29/6 |
| CF101 | 30 | 870 | 25 | 28/9 |
| CF102 | 15 | 300 | 60 | 22/5 |
| CF103 | 30 | 420 | 60 | 42/2 |
| CF104 | 30 | 580 | 75 | 44/10 |
| CF105 | 15 | 250 | 80 | 37/9 |
| CF106 | 12 | 200 | 100 | 38/2 |
| CF107 | 30 | 360 | 100 | 51/9 |
| CF108 | 12 | 135 | 150 | 53/11 |

| CODE No. | IND HY | DC RES | DC mA | RETAIL PRICE |
|---|---|---|---|---|
| CF109 | 20 | 225 | 150 | 56/4 |
| CF110 | 12 | 100 | 200 | 65/5 |
| CF111 | 16 | 165 | 200 | 65/5 |
| CF112 | 10 | 70 | 250 | 65/5 |
| CF113 | .5/20 | 70 | 250<br>50 | 72/1 |
| CF114 | 1.1 | 23 | 375<br>AC | 44/10 |
| CF115 | .017 | .6 | 2A | 19/8 |

## GRID INPUT TRANSFORMERS

| CODE No. | MATCHING FROM | TO | NOM. IMPEDANCE PRIM. | SEC. | MAX. WATTS | RETAIL PRICE |
|---|---|---|---|---|---|---|
| MT104 | Mike, P.U. | Grid | 3.7, 50 | 50,000 | | 44/10 |
| MT105 | Mike, P.U | Grid | 3.7, 50 | 60,000 | | 164/1 |
| MT108 | Line | Grid | 120 | 1200 | | 98/11 |
| MT109 | Cath. | Grid | 100 | 1000 | | 56/2 |

## LINE TRANSFORMERS

| | | | | | | |
|---|---|---|---|---|---|---|
| MT100 | Line | Spkr. | 600 | 4, 3 | 15 | 56/2 |
| MT101 | Line | Spkr. | 500 | 15 | 15 | 56/2 |
| MT124 | Line | Spkr. | 600<br>500 | 4, 3, 2.7<br>2.3, 2. | 25 | 94/5 |
| MT125 | Line | Spkr. | 600<br>500 | 15, 12.5<br>8.4, 6.5 | 25 | 92/2 |
| MT111 | Line | Spkr. | 500 | 12.5, 8<br>2.3 | 10 | 60/7 |

## MODULATION TRANSFORMERS

| | | | | | | |
|---|---|---|---|---|---|---|
| MT118 | Audio Amp | Class C Amp | 8000<br>6000<br>P.P. | 10,000<br>7000<br>5000 | 25 | 148/6 |
| MT119 | Audio Amp | Class C Amp | 8000<br>6600<br>3800<br>P.P. | 10,000<br>7500<br>6500<br>5500<br>4500<br>3500 | 50 | 171/- |
| MT120 | Audio Amp | Class C Amp | 500 to 20,000 in steps | 500 to 30,000 in steps | 50 | 312/7 |
| MT121 | Audio Amp | Class C Amp | 500 to 20,000 in steps | 500 to 30,000 in steps | 125 | 384/10 |

## DRIVER TRANSFORMERS

| | | | | | |
|---|---|---|---|---|---|
| MT106 | Class A Driver S.E. | Class AB1 Grids | 5000<br>Pri. DC 40 mA | 125,000<br>Step Up 1:5 | 5 | 98/- |
| MT107 | Class A Driver HI. MU. S.E. | Class A Grids P.P. or S.E. | 10,000<br>Step Up 1:3 | 90,000 | 1 | 143/- |
| MT112 | Class A Driver HI. MU S.E. | Class A Grids P.P. or S.E | 10,000<br>Step Up 1:2<br>5 mA DC unbalance | 40,000 | .5 | 89/11 |
| MT113 | Class A Driver S.E. | Class AB2 Grids | 5000<br>Step Down 1.25:1<br>40 mA Pri. DC | 3200 | 2 | 106/11 |
| MT114 | Class A Driver P.P | Class B Grids | 5000<br>Step Down 1, 1.5 or 2 | 5000<br>2200<br>1250 | 5 | 122/7 |
| MT115 | Class A Driver P.P. or S.E. | Class B Grids | 5000<br>Step Down 1.07 or 1.4<br>40mA DC max unb. | 4400<br>2500 | 5 | 122/7 |

## FILAMENT TRANSFORMERS

| CODE No. | PRIM. VOLTS | SEC. VOLTS | RETAIL PRICE |
|---|---|---|---|
| PF117 | 240 | 2.5V/.3A. | 29/1 |
| PF118 | 220, 240, 260 | 2.5V/5A 2.5V/5A. | 50/9 |
| PF158 | 220, 240, 260 | 5V/8A. | 56/2 |
| PF138 | 220, 240 | 6.3V/4A, 5V/4A, 2.5V/4A, 2.5V/4A. | 79/9 |
| PF162 | 240 | 6.3V/3A, 6.3V/3A. | 58/8 |
| PF154 | 200, 230, 240 | 7V tap 6V/7A. 6.3V/3A, 5VCT/5A, 5V/3A, 2.5V/7A | 168/8 |
| PF102 | 240 | 7.5V/2A. | 42/8 |
| PF111 | 240 | 10V/5A | 60/4 |
| PF131 | 230 240 | 10VCT/10A 5V/15A. | 179/11 |

ENGINEERED TO-DAY FOR TO-MORROW'S REQUIREMENTS

studio set, but the more usual procedure is to set up a camera in front of a high quality picture tube, fed from the program line. Although some degradation may be apparent in the picture as a result, the film automatically contains the fades and effects introduced electronically by the producer during the progress of the show.

US television stations have made free use of standard 16mm equipment for "canning" live shows, chiefly because of its convenience and economy. They consider that a good 16mm print will retain all the detail that a TV picture has to offer and that the use of 35mm equipment is therefore unjustified.

The danger is, however, that optimum conditions are not always achieved and the final result is poor, both in respect to the picture and the sound.

## MAGNETIC TRACK

The use of film having a magnetic rather than an optical sound track would appear to be beneficial. Not only is the magnetic track simple and capable of better fidelity, but it allows the photographic processing to be controlled purely in the interests of picture quality.

In one equipment recently described, the sound track is recorded and played back magnetically while the TV pickup circuits operate directly from the film negative. This avoids the inevitable loss involved in making the usual positive print.

Whatever the details of the film system, whether 16 or 35mm, optical or magnetic sound, certain difficulties have to be overcome in translating the filmed image into the appropriate television signals

World standard practice, for both 16 and 35mm sound film is to photograph and project at 24 frames per second. In other words, for each second of running time, 24 frames are exposed in the camera, and subsequently projected on to the screen.

## ROTATING SHUTTER

In the camera, each frame is left stationary in the film gate for a fraction of a second, then a rotating fan or shutter cuts off the light temporarily while the film is jerked down to expose the next frame.

During projection, the fan cuts off the light during each movement of the film and then cuts it off again for an equal period while each frame is still stationary in the film gate. Thus, each of the 24 frames is actually projected twice, making a total of 48 pictures per second.

Under average viewing conditions, this is sufficient to eliminate the sensation of flicker, except to viewers who are particularly sensitive in this respect.

For television relay it might appear, at first glance, sufficient to project the film image on to a screen in the usual way and scan it with an ordinary TV camera. Such a scheme is doomed to failure, however, because the camera lacks the persistence of vision which creates the illusion of a continuous picture in the human eye.

Thus, part of the time, the TV camera would be scanning a fully illuminated screen while, at other times there would be no light whatever on the screen, and the only output would be from the natural

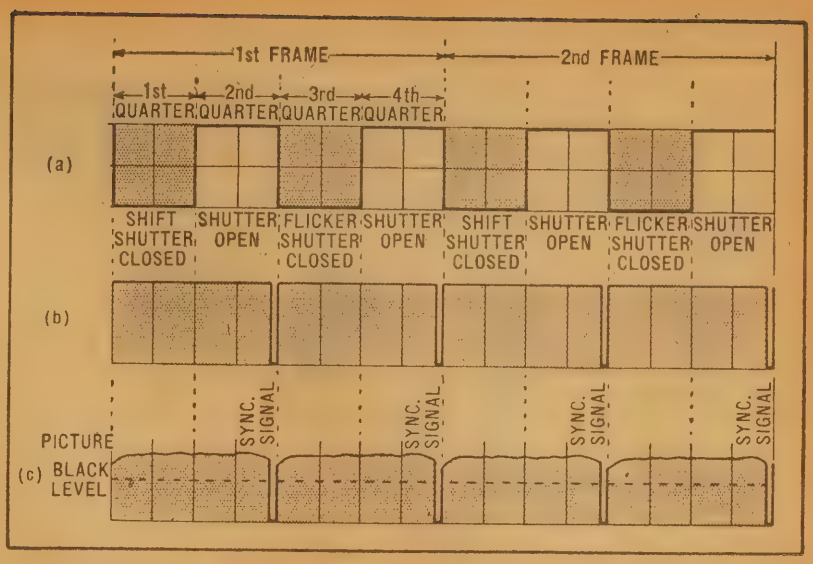



Figure 3. Illustrating the time relationship between the usual film projection shutter operation (a), the special television type shutter (b) and the television frame and picture signals.

storage effect of the picture tube mosaic.

The nett result would be overall flicker plus a pattern of dark bands moving across the screen as different segments of the television scan pattern coincided with black-out periods of the film image. Up till recently, there has been no satisfactory electronic substitute for persistence of vision.

It is interesting to note, however, that French and British engineers have apparently solved a somewhat similar problem to convert French 819-line pictures to the 441 and the 405 line standards.

In this cause, the high definition pictures were portrayed on the screen

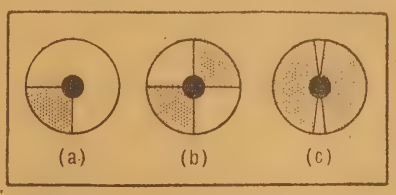



Figure 2. A simple "shift" shutter is indicated as (a), the more usual combined shift and flicker shutter as (b). (c) Shows the type of shutter used for television work.

of a picture tube and televised with cameras operating on the lower definition standards.

The persistance of the screens was built up so that the effect of the "writing" spot on the picture tube mosaic would not be lost before the slower moving scanning spot could reach it. Variations in average brilliance as the travel of the two spots coincided or diverged was countered by elaborate automatic brilliance compensators.

At the same time, the screen persistance and the operation of the electronic circuits had to be limited so as not to prejudice seriously the ability of the system to portray movement.

While it seems that such a system would inevitably degrade the picture to some extent, the very fact that it was possible at all is significant and the method may well be evolved as a simple film-to-EV transfer, as well as a means of interchanging television standards.

In the meantime, there are a number of accepted methods which must be explained.

British television stations are in the fortunate position, in this respect, in that their standard 50-cycle frame frequency, selected originally to coincide with the mains frequency, is very close to the projection rate for motion pictures.

By speeding up the film slightly to run at 25 frames per second instead of 24, the picture projection rate of 50 per second can be made to coincide with the television scan rate. It is a relatively simple matter to synchronise the projector motor to the framing pulse — or vice versa.

## SCANNED TWICE

It simply means that each individual frame on the film is scanned twice — once for the odd and once for the even lines of the interlaced scanning pattern. The slightest increase in the rate of movement on the screen and the accompanying rise in the pitch of the sound is generally reckoned to be of no practical consequence.

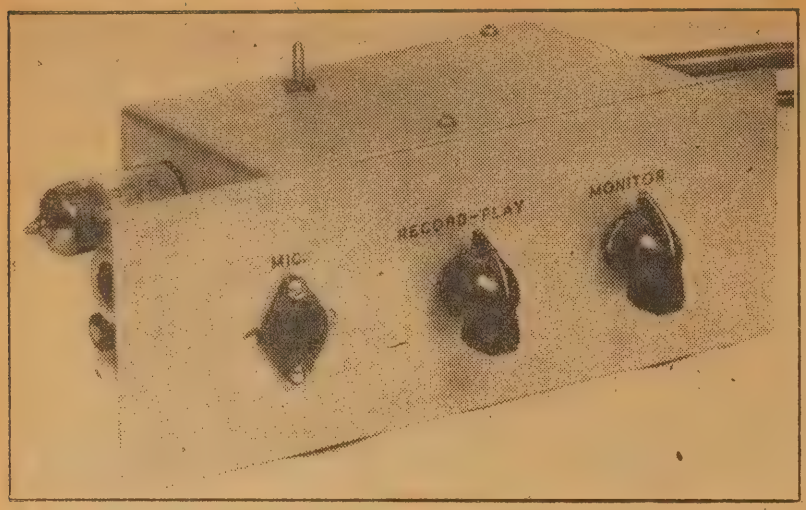
A difficulty arises, however, in that the interval between television half-frames — equal to the retrace time — is only a fraction of the "pull-down" time for a film in the standard type of intermittent projector. Neither is it possible to decrease the pull-down time by much, because too rapid accelration damages the sprocket holes in the film, and makes it difficult also to ensure that each frame falls exactly into register with the last.

## STORAGE EFFECT

It becomes immediately obvious that, if the film cannot be jerked into position fast enough, then the shutter will not be open in time for the beginning of the frame scan and it will also close before the next scan is completed. In other words, some of the odd and some of the even scan lines will be missing at the top and bottom of the picture.

The difficulty has been solved in part by relying on an interesting property of some camera tubes,

(Continued on Page 91)




A front view of the complete adaptor. The valve behind the panel is the 12AT7 oscillator, and the shield of the pre-amplifier can just be seen in front of it. On the left of the front panel is the microphone input socket, in the centre the "Record-Play" control, and on the right the monitor volume control.

# THE R & H TAPE ADAPTOR No. 1

**By building this new adaptor and attaching it to your present equipment, you can make your own tape records from radio, pickup or microphone and play them back again with good quality and volume. Compared with a complete tape record-playback amplifier, the adaptor represents a big saving in first cost.**

THE need for such an adaptor and its likely popularity with readers has been evidenced for some months by the oft-repeated question . . . "Can I use my Playmaster for tape recording?" or "Can I make tapes from my present radio?"

The answer to both questions is yes, provided you are willing to build a special adaptor unit. There is more to it than just a couple of connections to the pickup and output terminals.

To make a tape recording in the first place, it is essential to provide high frequency bias for the recording head and this involves the provision of a special oscillator valve with its associate coil and components.

## PREAMPLIFIER

Then again, on playback, the signal available from the tape is of quite low order, and it is essential to provide a high gain preamplifier stage between the head and the normal pickup terminals to the amplifier. This involves a second valve and the appropriate wiring.

To this must be added the necessary record—playback switching, plus a compensating network to ensure a reasonable tonal balance. Unless some such compensation is provided as part and parcel of the system, the final reproduction will be notably lacking in both bass and treble.

In special cases, the amplifier may already have a microphone preamplifier channel, plus bass and treble boost, and these facilities could conceivably replace equivalent circuits in the adaptor. However, apart from the fact that such circuits are the exception rather than the rule in domestic amplifiers, complications might arise in providing switching which would simultaneously control the preamp. input and the bias oscillator.

For the time being at least, it is logical to assume that most adaptors would be used with conventional receivers and amplifiers having an audio input sensitivity of about 0.25 volt.

Summarising the position, therefore, it would appear that the design of a versatile adaptor must satisfy the following requirements:

(1) The adaptor must include a separate high frequency bias oscillator.

(2) It must include also a high-gain preamplifier for playback. The same valve might be used, during recording, as a microphone amplifier, its output feeding in either case into the pickup channel of the main amplifier.

(3) The circuit should provide enough inherent compensation to ensure reasonably level response through average equipment.

(4) Record playback switching should be incorporated, together with a means of controlling speaker volume during recording.

(5) The adaptor should not draw more heater and HT current than necessary, enabling it to be powered, in most cases, from the receiver or amplifier supply.

These general requirements could be met with a variety of circuit arrangements, but, for sheer simplicity and effectiveness, there would seem to be little point in doing anything else but extracting the relevant sections from the Radio and Hobbies "Tape Recorder No. 1," as featured in the November issue.

Reduced to its essentials, the circuit breaks down quite simply. To-together with the power supply, the last two valves constitute what is essentially a basic single-ended amplifier, having an input sensitivity of approximately one volt.

## BASIC AMPLIFIER

It should be possible simply to replace this basic amplifier with any other amplifier or audio system having roughly equivalent gain and power output. The head will then simply be fed through the same compensating T-pad from the output plate or from either plate in the case of a push-pull amplifier.

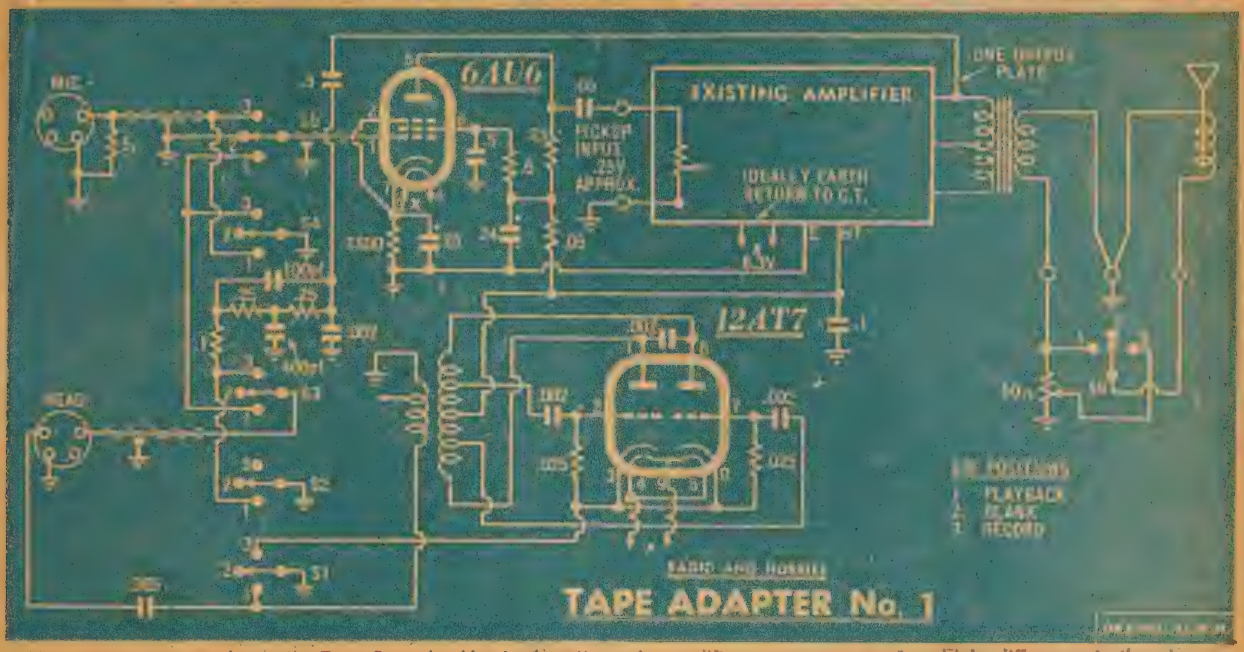
The T-pad can be relied upon to effect most of the necessary compensation although, for good measure, the basic amplifier in the Recorder No. 1 circuit had additional bass and treble boost.

At the worst, a perfectly flat audio system will lack the extreme bass and extreme treble of the original circuit but results should nevertheless be very acceptable. At the best, bass and treble controls, as in the "Playmaster" series, might give even greater flexibility than originally provided. But more of this later.

The level indicators have been omitted, too, in the interests of simplicity and economy. They are handy but not essential. After a little practice, you will get used to recording with the knobs in certain positions.

*by Philip Watson*

# CIRCUIT DIAGRAM OF R & H TAPE ADAPTOR No. 1




The circuit is very similar to the Tape Recorder No. 1 minus the main amplifier and power supply. Main difference is the absence of one switch section, formerly used for feedback control, and the provision of a monitor speaker volume control.

That leaves only the bias oscillator. As we have been careful to explain on prevoius occasions, the intending constructor has to make a deliberate choice as to recording method in order to choose the appropriate type of oscillator circuit.

In the Tape Recorder No. 1, we used a low-powered oscillator sufficient to supply only the recording bias. It was assumed that the tape would be erased with a 50-cycle erasing transformer, as supplied commercially.

This type of circuit has a special advantage for adaptor use in that its HT current requirements are so small. The original adaptor drew 4 milliamps total at 260 volts, when recording, and a a mere 1 milliamp on playback. Neither figure would be significant for even a modest power supply.

## ERASING

But it does mean that you will have to use full-track recording and erase the tape afterwards with either a 50-cycle erase transformer or a permanent magnet erase. We are planning to do some work with both systems in the near future from the home-constructors "junk box" approach.

If you want half-track recording in the interests of tape cost, then HF erase must be provided and a high-powered oscillator. You can expect such an oscillator to pull the best part of 20 milliamps and this may be too much extra to load on to an existing supply.

We have a second amplifier "on the skids" now, using a high-powered oscillator, and the information will be published in a couple of months' time.

The general design of our adaptor therefore becomes apparent, while the necessary connections to an existing receiver or amplifier should be easy enough to follow.

On record, the switching system connects the head through the T-pad to the output plate, or to either one of the plates in the case of a push-pull amplifier. At the same time, the bias oscillator is switched on and whatever signal is present at the output plate will record on the tape.

Thus a receiver will record directly while playing radio. A pickup can be fed either into the normal pickup terminals or through a pad into the adaptor. A microphone would need to go through the adaptor in any case and thence into the pickup terminals.

On record, the speaker voice coil is fed through the low resistance potentiometer, so that it can be operated at reduced volume if required when recording or turned off altogether if you are using the microphone.

On playback, the bias oscillator is cut off. The output from the head is simultaneously diverted to the preamplifier stage, thence via the pickup terminals to the main amplifier. At the same time, the speaker voice coil is switched to full-on and the set plays normally.

## SWITCHING

As in the original recorder, auxiliary sections on the switch short out "floating" grid and plate leads and thus minimise risk of feedback. It is most important to avoid feedback paths in the wiring and we suggest that you follow in detail the lay-out arrangements worked out for the original adaptor.

## PARTS LIST

1 Chassis 5½"x4"x2½"
1 Panel 8¼"x3".
1 Shield panel 5½"x2½".
1 6AU6 valve.
1 12AT7 valve.
1 Miniature 7 pin socket and shield.
1 Noval socket.
1 Switch, 3 pole, 3 position, 2 bank double spaced.
1 bias oscillator coil.

Resistors

1 5 meg. ½ watt.
1 .5 meg. ½ watt.
2 .25 meg. 1 watt.
1 .25 meg. ½ watt.
1 .1 meg. 1 watt.
1 .05 meg. 1 watt.
2 .025 meg. ½ watt.
1 1500 ohm 1 watt.
1 50 ohm wire wound pot.

Capacitors

1 25 mfd. 40 volt electrolytic (See text).
1 24 mfd 350 volt electrolytic.
2 .5 mfd 350 volt miniature paper.
1 .1 mfd 350 volt miniature paper
1 .05 mfd 350 volt miniature paper.
1 .005 mfd 350 volt miniature paper.
4 .002 mfd mica.
1 400 pf. mica.
1 100 pf. mica.
Tag strips: 1 2 terminal, 2 3 terminal, 1 4 terminal, 1 5 terminal, 1 8 terminal.
3 terminals.
1 yd PTIM co-axial cable.
1 yd shielded hook-up wire.
2 pointer knobs.
2 miniature 4 pin speaker sockets and plugs.
Hook-up wire, plastic sleeving, solder lugs, nuts and bolts etc.

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'33' — '45' — "MICROGROOVE"

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TAPE

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MAGNOFILM

TAPE DECK MODEL TM-1

## A 'FOOLPROOF' TURNTABLE DRIVEN TAPE RECORDER

For a considerable period the brand of "BRS" has been associated with high quality disc recording and reproduction.

Constant and extensive development has proceeded on methods of obtaining still greater realism in recorded sound, and as a result the "BRS" Magnofilm Tape Deck is now proudly presented as a precision instrument for magnetic recording.

Your "BRS" Turntable has adequate power to drive this fascinating new product at truly constant speed, and enables the enthusiast to enter the field of tape recording economically.

Whether it's for the simplest recorder or for the most elaborate applications, the Magnofilm Tape Deck has been designed to provide lifelike reproduction, and its capabilities are governed only by the quality of the equipment with which it is used.

With full details of oscillator unit, equalising network and pre-amplifier available, your present amplifier can be incorporated to provide a high quality tape recorder and reproducer.

The Magnofilm Tape Deck offers super-simplicity of operation . . . . . in fact it's foolproof.

### FEATURES

*Records from microphone, radio or pickup.*
*Dubs from tape to disc.*
*Dubs from disc to tape.*
*Two tape speeds—7½in per sec. at 78 r.p.m.*
*—3¾in per sec. at 33 1/3 r.p.m.*
*Loads 1200ft tape on standard 7in reels.*
*True constant speed.*
*Wide-range frequency response.*
*Mechanical rewind.*
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A. E. Harrold, 123 Charlotte Street, Brisbane. B2729.

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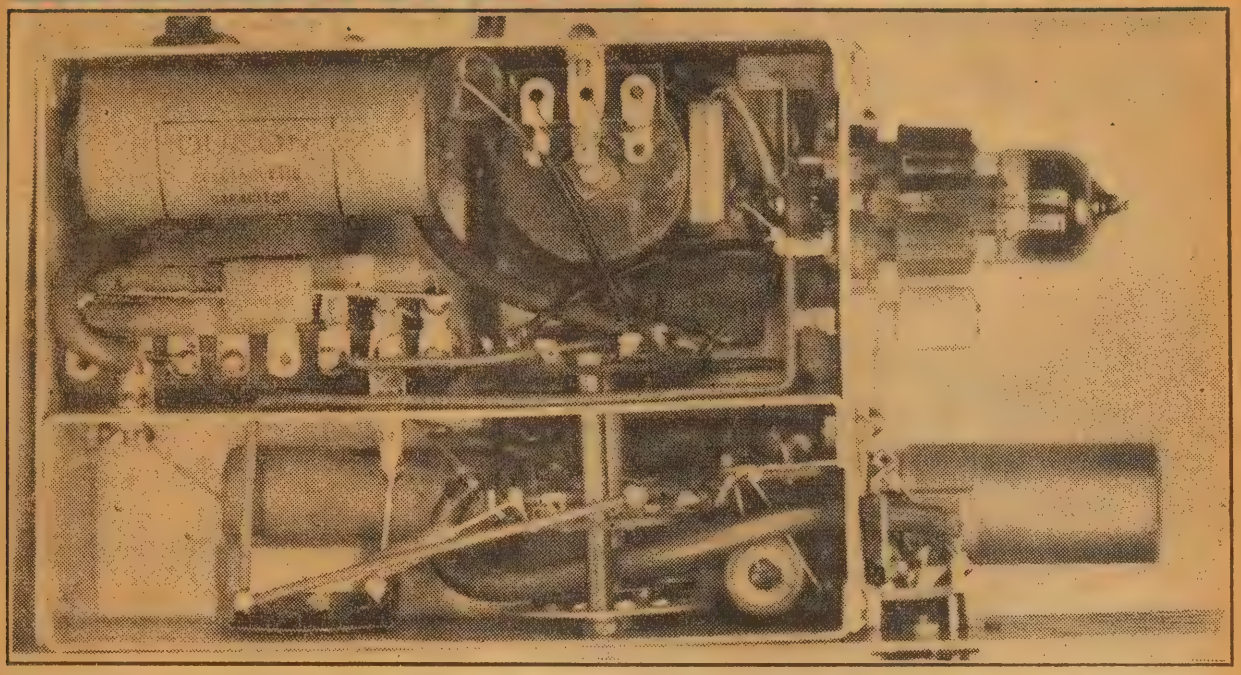
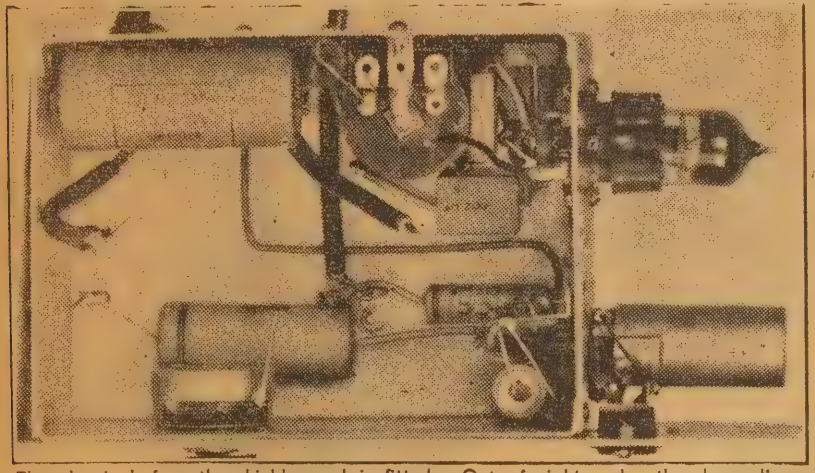
# CLOSE-UP PICTURES OF THE TAPE ADAPTOR



The underside of the completed unit. The pre-amplifier stage is at the bottom right hand corner, the oscillator at the top right hand corner with the oscillator coil slightly to the left. In the top left corner is the decoupling capacitor and compensating T pad.



The chassis before the shield panel is fitted. Out of sight under the decoupling capacitor is the power cable tag strip, the decoupling resistor and the .1 mfd HT by-pass. The capacitor just above the volume control is the pre-amplifier screen by-pass.

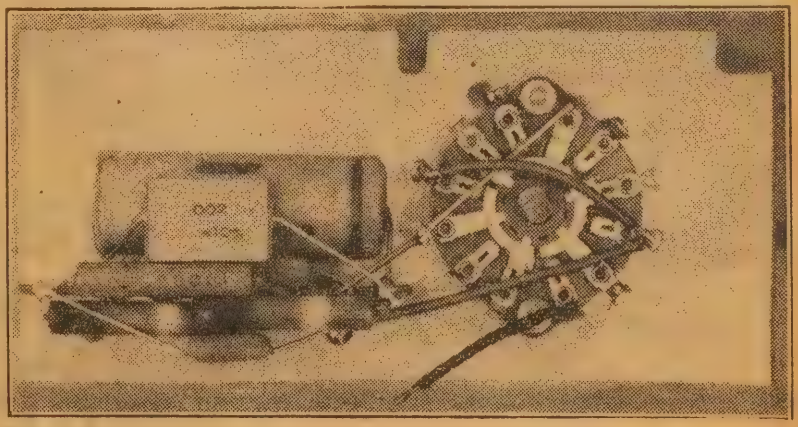
The necessary heater and HT supply can be picked up from a heater circuit in the main amplifier and from the normal B-plus line at about 250 volts. Ideally the heater should be operated from a winding whose centre-tap can be earthed rather than one side.

From the purely physical angle we decided that there would be some advantage in making the unit reasonably small, thus enabling it to be added to existing equipment without too much bother. As it is it should be quite easy to mount it in an odd corner of a domestic receiver or radiogram cabinet or alongside an amplifier chassis without calling for a major alteration to the layout.

The panel measures 8¼in x 3in and the chassis 5¼in x 4in x 2½in deep and it may be mounted either horizontally or vertically depending on the space available. There is, of course, no reason why a larger chassis could not be used if the space to house it is available and you can please yourself in this regard. One suggestion is to use the chassis designed for the No. 1 Tape Recording Amplifier, with the idea that the adaptor can be made into a completely self contained tape amplifier at a later date if desired.

However, regardless of whether you decide on our layout or not, there are two important points to be observed. One is that the original switch layout be followed and the other is that there be adequate shielding between the oscillator and preamplifier sections.

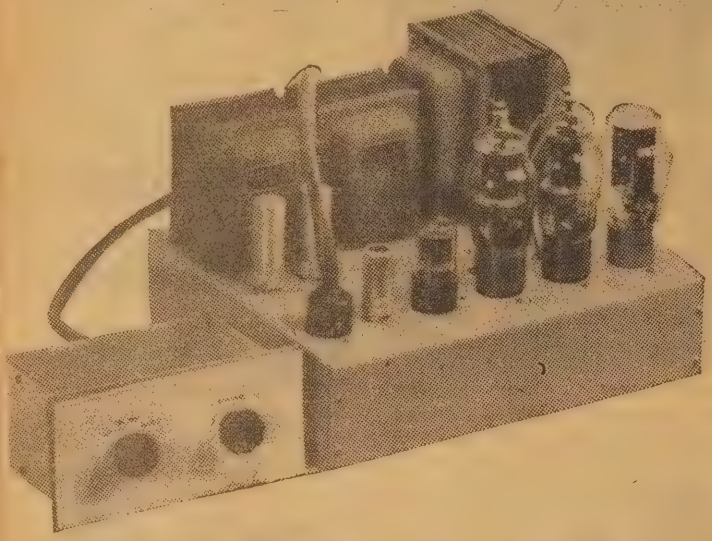
The first precaution is necessary to prevent coupling between input and output (whether in the recording or playing positions) with consequent instability, and the second is to prevent any injection of the



The dividing shield showing the rear section of the switch and the compensating T pad. All the components for the T pad are accomodated on a single 8 terminal strip.

# *HI-FIDELITY ENJOYMENT... WITH A "PLAYMASTER"!*

There is a Playmaster unit to suit every requirement of the hi-fidelity enthusiast. Designed by "Radio & Hobbies" and produced in kit form or completely built by the specialists, Electronic Parts Pty. Ltd.



## The Playmaster range includes:---

- ★ **Amplifier No. 1 (5 Valves 18 Watts)**
- ★ **Amplifier No. 2 (5 Valves 10 Watts)**
- ★ **Amplifier No. 3 (3 Valves 4 Watts)**
- ★ **Amplifier No. 4 (3 Valves 4 Watts)**
- ★ **Amplifier No. 5 (5 Valves 10 Watts)**
- ★ **Tuner No. 1 (2 Valve D/W & B/C)**
- ★ **Whistle Filter**
- ★ **Tuner No. 2 (3 Valve T.R.F. with Filter)**
- ★ **Wide Range Tuner (1900 KC with Filter)**
- ★ **Control Unit No. 1 (1 Valve with Vol. Cont.)**
- ★ **Control Unit No. 2 (De Luxe Model)**
- ★ **Control Unit No. 3 (Special Type)**

*These, and other amplifiers are described in our Amplifier Price List. Send coupon. Write or call for your copy.*

## FUN and FIDELITY in TAPE RECORDING..

Bring a B.R.S. Magnofilm Tape Deck to your Playmaster and you enjoy the fun of recording social events, family happenings, and so forth, yet still retain that hi-fidelity so necessary for record reproduction.

- Playmaster Tape Recorder No. 1 (An amplifier designed for most types of tape decks.)
- B.R.S. Magnofilm Tape Deck (Operates from most gramo-motors).
- E. P. Pre-Amp-Oscillator (A new unit specially designed to enable Playmaster Amplifier No. 2 and Control Unit No. 2 to be used with B.R.S. Magnofilm Tape Deck). Tape Recorder No. 1 and Pre-Amp-Oscillators are available as kits or completely built.

Write for descriptive list.

MAGNOFILM

*Dear Sirs,*

*Please send me, without obligation on my part, your amplifier catalogue. (Stamps enclosed to cover postage.)*

*NAME* .....

*ADDRESS* .....

.....

# ELECTRONIC PARTS

**PROPRIETARY LIMITED**

*The Kit Set Specialists*

E. S. & A. Bank Building, Corner Broadway & City Road, Sydney. MA1661.

oscillator signals into the preamplifier which, if strong enough, can severely overload this stage.

In our original model these troubles are virtually non-existent, though there was some tendency to feedback with our initial layout and this was subsequently cured by modifying the switch connections.

As can be seen from the photographs, the chassis is divided into two sections by means of a metal shield and this also separates the two switch wafers. This shield performs two functions; one to shield the preamplifier circuit from the bias oscillator, and the other to prevent coupling between the circuits connected to the two switch wafers.

The switch is a two-bank, three-pole, three position, and should be of the double spaced variety having long spacers between the banks These are normally available to special order if your dealer does not carry stocks, though it is probable that most dealers will have them available by the time this appears in print.

The switch will have to be modified slightly to enable it to be mounted on the dividing shield. To do this the rear wafer and the two long spacers should be removed and each spacer cut into two, the shorter portion in each case being 3/16in long. The switch is then reassembled with the dividing shield between the two sections of the spacers.

Because of the rather compact construction it is important that the wiring of each section be done in the correct order, otherwise some of the connections will be found to be built out when the time comes to make them.

First job is to wire the preamplifier stage. This socket is in the end of the chassis toward the front and should be mounted with the space between pins 1 and 7 uppermost when the chassis is inverted for wiring. The bias resistor and associated electrolytic capacitor are mounted upright in the corner of the chassis alongside the valve socket and are earthed to the centre terminal of a three-terminal tag strip.

This tag strip is held by one of the bolts holding the dividing shield and also serves as a HT anchor point. It is unlikely that any but the very smallest 25 mfd electrolytic will be suitable for this layout and the larger types should be avoided.

## PREAMP. LAYOUT

The plate and screen resistors, both half-watt types, are mounted between the appropriate socket pins and a terminal on the tag strip which serves as the HT anchor point. The screen by-pass is rather bulky, even in the miniature types, and needs to be mounted toward the other end of the chassis near the speaker volume control.

The plate coupling condenser mounts against the top of the chassis and is connected to a terminal on a two-terminal tag strip near the centre of the dividing shield. From here a length of shielded cable passes through a small cut-out in the shield and out through a hole in the rear of the chassis. Ideally, this cable should be of the low capacity variety, such as PT1M co-axial, but if shielded hook-up wire must be used, the cheap, high capacity, variety should be avoided.

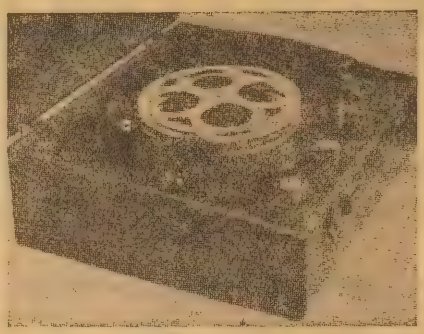
A short length of shielded cable, protected by insulated sleeving, con-


Convert Your Gramophone to a real

# TAPE RECORDER

FOR ONLY

**£12/10/- complete**



**GRAMOTAPE KIT**

*comprises*

1 reel E.M.I. tape.
1 take up reel.
1 clutch system.
1 record/playback head kit.
1 erase block.
2 corner brackets.
1 roller.
1 oscillator coil & all resistors and condensers, inc. valve socket.

**FULL VERY EASY INSTRUCTIONS.**

The results from this super little recorder are amazing. You can record direct from the radio or microphone with quality usually associated with high priced recorders. This GRAMOTAPE recorder uses your turntable as the flywheel and the radio as the amplifier All you need is a little radio knowledge to follow a very simple one valve circuit for the oscillator coil cum-pre-amp, and there it is, all ready to record. NO PARTS TO MAKE. All that's required is a soldering iron, plyers, and screwdriver

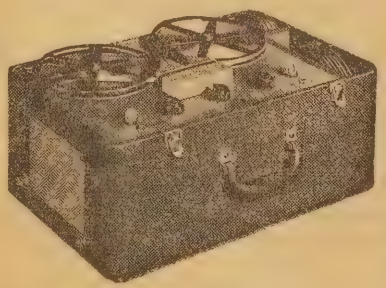
**Come in for a demonstration of this new, inexpensive recording idea that has been outstandingly successful in England for a long time.**

**Magnetic Tape Recording Heads**

Outstanding value. High fidelity kit set contains Balanced bobbin, mu. metal strip. Chrome case. Stalloy packing. Very simple to assemble. High impedance. ... **£1/12/-**

Beginners' Head Kit Record/Playback. Low impedance kit contains mu. metal strip, coil wire, head case. Very simple instructions. ... **17/6**

*Magnetic Sound Industries (Aust.) stock*



# COMPLETE RECORDERS

Is Australia's only tape recording specialist and as such has the largest range of branded and guaranteed tape recorders. They recommend and stock only the leading makes, such as MAGIC-TAPE, ELCON, SOUNDMIRROR, EDISWAN, B.S.R. SIMPHONIC, as they are good quality instruments and require the minimum of service. They are obtainable for as little as £19/10/- deposit and easy weekly payments. New and Second-hand.

## RECORDING ACCESSORIES DEPARTMENT

**This new dept. of Magnetic Sound Industries is now fully stocked and offers the following for the home constructor.**

| | | | |
|---|---|---|---|
| Record/playback head kits from | 17/6 | MOTORS | £3/10/- |
| Erase head kit | 17/6 | FLYWHEELS | £2/10/- |
| Oscillator coils (inc. circuit) | 18/6 | CHROME REEL HOLDERS | 12/6 |
| MU. METAL strip | 3/-, 5/4, 6/6 | PLUGS, JACKS | 4/6 |
| Head cases (chrome) | 12/6 | PANELS, ETC., SOLD SEPARATELY. | |
| Empty reels, all types | 8/6, 9/6, 10/6 | | |
| Tape from (E.M.I., Scotch Boy, etc.) | £2/2/- | | |

Radiogram cabinets, originally made for £200. Recorder grams to clear at ... **£28/10/-**

**New Release turns your Radio into a Tape Recorder Amplifier**

Converter amplifiers for any tape Deck . . . Complete with oscillator coil valves, switch, etc., mic. input. Wired and tested. ... **£12/10/-**

EASY TERMS ON ANY ARTICLES. MAIL ORDER WITH CONFIDENCE. On any type of recording equipment, consult Australia's only specialist.

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# A.C.E. RECORDING EQUIPMENT

AVAILABLE TO THE PUBLIC FOR THE FIRST TIME

**TYPE G4 DECK as illustrated. Fully assembled, tested and finished in beautiful brocaded lacquer, less heads.**

**£17/19/6**

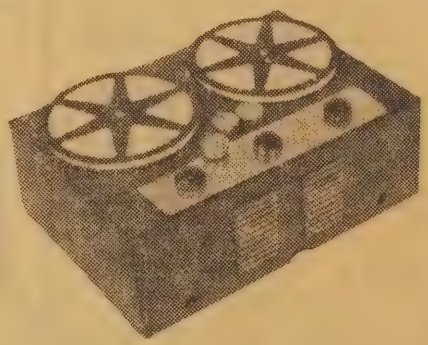
This unit although similar to R & H DECK (Dec. '52) in appearance has many advanced features including fully enclosed drive and fast forward and rewind (6 minutes). Also instantly adaptable any normal turntable.

---

**TYPE S3 DECK, as illustrated, is supplied completely assembled and tested, in highly finished brocaded lacquer cabinet 10½" x 15" x 5".**

PRICE INCLUDING MOTOR. LESS HEADS

**£29/15/0**



Features include fast forward and reverse without unthreading tape or changing reels. Large Flywheel to capstan ratio insuring substantially wow-free reproduction. Room in cabinet for amplifier, oscillator and monitor speaker. Motor supplied for 240V AC or 6V DC operation. All parts available separately. Large stocks of gramo-units available. Also complete recorders.

Lowest prices in Sydney.

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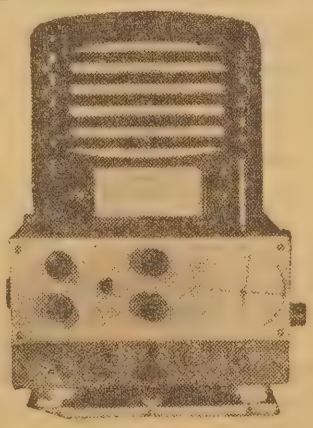


## FAMOUS MN26A COMPASS RECEIVER

**Converted to 240V AC Complete**

**£29/17/6**

## 1196 TRANSCEIVERS

4 Freq. locked Xtal 3-9mcs. Complete with 1 Trans. 1 Rec. Xtal. NEW AIRTESTED

All plugs and cables, remote control. 12 and 24 volt as required.

**£45/-/-**

## TYPE 101 TRANSCEIVERS

6 volt operation 4.2-6.8 mcs converted to crystal control with power supply end one crystal (to order).

**£27/10/-**

## EXCEL KITSETS

Kitsets available for all popular R & H circuits at lowest prices. Our simplified four-colored circuit diagrams make success a certainty. Telephone technical service available day or night. Enquiries welcome. Ring LA3845.

## WANTED

Transceivers F56, 101, No. 11 19, 22, ATR2B, etc. Also Communications Receivers, P.A. and Test Equipment. State price wanted and fair description of condition and completeness.

nects to the grid pin of the 6AU6 socket and is made the correct length to reach the appropriate contact on the front switch deck when this is finally fitted into place. The outer braid is earthed to the same terminal as the bias resistor and capacitor. When this part of the wiring has been completed, slip the shield into place temporarily to make sure that it does not foul any wiring or components.

If all is well, remove the shield and proceed with the next stage, which is the wiring of the oscillator section. A pair of twisted leads run from the filament pins of the 6AU6 socket, through a cut-out on the corner of the shield, to the filament pins of the 6AT7 socket and then to a tag strip at the rear of the chassis.

The main components for the oscillator circuit, the grid resistors and capacitors and the plate to plate capacitor, can be mounted directly on the socket pins and the oscillator coil terminals. The oscillator coil we used had its own terminals for the five primary connections and three loose leads for the secondary. A three terminal tag strip takes care of the latter and this can be seen in the photographs above the oscillator coil. A short length of hook-up wire should be left connected to the cathodes of the 6AT7 for eventual connection to the switch.

We understand that a smaller oscillator coil, having the same electrical characteristics, is about to be released and this will probably require a tag strip to accommodate all its connections. The coil we used has two alternative secondary connections providing a high and low output. We used the high output connection, being the black lead, with the green lead earthed.

## HEAD SOCKET

At the rear of the chassis is a four pin miniature speaker socket which provides connection to the recording head. One pin connects to the bias coil through the .005 mfd capacitor, a second one connects to earth, and to a third must be connected about four inches of shielded hook up wire with insulating sleeving. The braid can be earthed at the earthed pin of the socket.

At this stage it will be wise to check the fitting of the shield again and it will probably be found that the oscillator coil may have to be loosened slightly to allow it to slip into place.

Next step is to wire the incoming power leads and the decoupling circuit for the pre-amplifier. This section is against the rear of the chassis at the opposite end to the valves. First there is a four tag terminal strip mounted against the top of the chassis and to this is brought the filament leads, HT lead, and earth lead from the main amplifier. Alongside it is placed the .1 mfd capacitor by-passing the HT line.

The leads are brought through a grommet in the rear of the chassis and as well as the power leads there is a shielded lead to connect to the output plate of the main amplifier. This lead is not terminated on a tag strip at this stage, being simply brought inside the chassis for a distance of about 4in and covered with insulating sleeving. It ultimately connects to the compensating T pad.

Because of the lower impedance of the plate circuit the use of a low

**(Continued on Page 87)**


# YOU CAN BUILD

**A PROVED, PROFESSIONAL TYPE COMPLETE TAPE RECORDER DECK**

***FOR AS LOW AS* £34/8/3**

**with full confidence in success, because it is designed by experts**

**THESE DECKS COMPLETELY BUILT UP AND TESTED FROM AS LOW AS £39/19/-**

**We were the first to release Tape Recorder Heads, Kitsets for Tape-Decks, Tape Recorder, Amplifiers and Converters, etc., etc.**

**ALL PARTS featured in "Radio and Hobbies" Tape Recorder Articles AVAILABLE FROM "NOVATAPE."**

**Now we offer**

**The LOWEST PRICED Magnetic Recording HEADS**

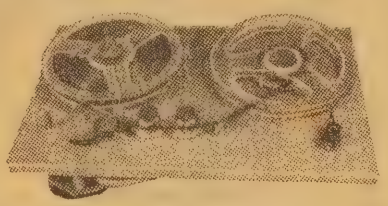
**Type 52 R/P Half Track Record-Playback Heads.**
**Type 52 E Half Track Erase Head (Supersonic).**
Including circuit and details, **£4/9/6 each**

**GUARANTEED** Distortion-free recordings from 25 c/s to 8000 kc/s with suitable circuits and good quality high coercitivity tape at 7½ inches per second speed. High Impedance and therefore **NO** costly Coupling Transformers required. "NOVATAPE" Magnetic Heads are being used in recording studios by broadcasting stations and by manufacturers of magnetic tape recorders. This should convince you that more expensive heads are not necessary.

**"Novatape" Oscillator Coil, 30 to 60 kc/s.** Including circuit and details. **16/6 each**

## NEW "NOVATAPE" RELEASES:—

Type G **Tape Recorder-Attachment** for Gramophone Turntable 2-speed fast forward and hand or 6-minute rewind.
Complete Mechanical Kit ready to assemble (Heads extra). . . . . **£13/19/6**
Assembled and tested with two heads. (Supersonic erase.) . . . . **£29**



## Type F DECK

2-speed, fast rewind and forward tape lifted off heads automatically on rewind. Single knob control.
Complete mechanical kits ready to assemble . . . . **£32/17/-** (Heads extra.)
Assembled and tested with two heads. (Supersonic erase.) . . . . . **£54/-/-**
Complete Portable Recorder . . . . . **£119**

## 'MIDGET' CONVERTER:

A Small Recording Pre-Amplifier/Oscillator Attachment to be used with Radio or Standard Amplifier Kitset (inc. Valves), Circuit and Full Instruction. . . . . **£9/18/-**
Completely Built-up and Tested. . . . . **£12/18/-**

## TYPE A DECK. (2motors)

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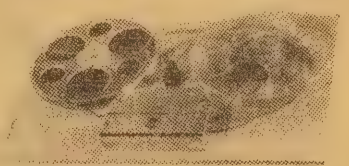
Assembled and tested with two heads. (Supersonic erase.) . . . . . **£39/19/-**
Complete Portable Recorder . . . . . **£99**



**Other Recorders for £154, £164, £167, £179**

Other Kitsets and Decks. Details on application.

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**OPEN SATURDAY MORNINGS AND WEEK-DAY NIGHTS.**

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**THE MANAGER, NOVA ELECTRICAL & ENG. CO.**

*Please send me, without obligation, further details and prices of Kitsets for Tape Recorders.* ☐ *Complete Decks, Amplifiers and Recorders.* ☐ *Oscillator and principal Recording Circuits with description.* ☐ *Points to be considered when building or purchasing Tape Recording equipment.* ☐

*I enclose large self-addressed envelope and 6½d stamps.*

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WELL PACKED. POST (insured) 7/6.

## Yankee Naval Jackets 49/6 each

Brand New YANKEE WATERPROOF NAVAL JACKETS

TROUSERS to Match .. .. .. 44/6
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BRAND NEW
SUPER QUALITY 14½ to 17½.

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Brand new STC complete with cord and plug.
2000 ohms impedance. Suitable for Crystal Sets.
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with 14oz. Proofed Duck Roof. No fly necessary. Brand new.

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## AUTO TENTS

14ft x 8ft

14oz. PROOFED DUCK TOP with Duck Walls. Brand New.
Complete with ropes, poles, etc.
LEAN-TO gives you verandah 7ft x 8ft for your car and one spacious room for living.

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## SPANNER OUTFITS

Special purchase. Best Quality Spanners. All Brand New, in following sizes:

SET OF 6 DOUBLE-ENDED RING SPANNERS, SAE:
⅜ x 7-16, ½ x 9-16, ¾ x 11-16, 2 x 25-32, 13-16 x ⅞, 15-16 x 1..

SAE SET SPANNERS
¼ x 5-16, ⅜ x 7-16, ½ x 9-16, ⅝ x 11-16, ¾ x ⅞, 15-16 x 1.

1 Pair Pliers, 1 Pair 6in. Sidecutters, 1 6in. Crescent type Shifting Spanner, 1 10in. Crescent type Shifting Spanner, 1 metal Toolbox, 14in. x 7in. x 4in.

**The Lot, £8/9/6**

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## Army Greatcoats

S.M., M.
Post N.S.W. 3/11, Interstate 5/4. **47/6 ea.**

## MARQUEES

BRAND NEW

12oz. Proofed Duck Top with 8oz. Duck Walls. Complete with Ropes. Poles, etc. 6ft. Walls.

10 x 10 £28 12 6—save £15
12 x 12 £32 17 6—save £19
15 x 15 £44 1 9—save £22

14oz. Proofed Duck Top with 8oz. Duck Walls.

10 x 10 £31 —save £15 15 -
12 x 12 £35 7 -—save £20

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## CALICO FLOUR BAGS

Super Quality unbleached Calico 50lb Flour Bags. Ideal for pillow slips, tea towels, laundry bags, meat bags, or for sending food parcels.

**15/- PER DOZEN**

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EVERY GALLON GUARANTEED

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4 GAL DRUM **£4/19/6**

2 Gal. Drums, 55/-.
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Please add 2/6 per drum cartage to rail; freight payable at your nearest attended Railway Station.

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# DEITCH BROS.

**Dept. W., 70 OXFORD ST., SYDNEY**

(Almost opposite ARNOLDS)

# USING SILENT SOUND

(Continued from Page 15)

been gained by the application of ultrasonic vibrations of a frequency of about 800,000 cycles per second. Benefit has been attained in the treatment of sciatica and neuralgia but enough has not been done to warrant as yet a high degree of expectation. Considerable care must be exercised in the application of the waves and much damage may be done by inexperienced people.

It has been found that it is possible to apply heat to the bone marrow by these waves, something which can be done in no other way. This may be a very beneficial thing in the future.

## WAVES TEAR TISSUE

Waves of certain frequencies have a distinct effect on the nervous system. Some frequencies can literally tear tissue and cells to pieces by means of the enormous energy produced.

So far, it has been concluded by eminent authorities, the effects of the application of ultrasound to the human body is mainly the production of heat. As this is done far more effectively with ultrasound than by any other method it seems that it is in this field that ultrasound will ultimately find its place in medical science. Ultrasound is undoubtedly a potent physical force and examination of its possibilites as a healing and diagnostic agent is going on continuously.

A most efficient but costly instrument was shown and explained to me recently. This is an ultrasonic wave detector used to detect ultrasonic vibration in rapidly moving parts. It is used to great effect on the structure of jet planes.

## PRODUCED IN MACHINES

It seems that much ultrasound vibration is produced in certain machinery. This may be transmitted to the structure of the machine and could cause damage.

This instrument, consists of a barrel about the size of an electric torch with a flexible tube protruding from one end. The end of this tube which is about a quarter of an inch in diameter consists of a small diaphragm connected to a suitable electronic circuit by a long flexible shielded lead. In use the instrument is passed over the part to be examined and any ultrasound is immediately picked up, amplified, and made visible on a cathode ray tube. Thus any vibration found can be damped out or otherwise suitably treated.

It is certain that we will hear much more of ultrasound in the future. It promises to be one of the most useful forces at our disposal.

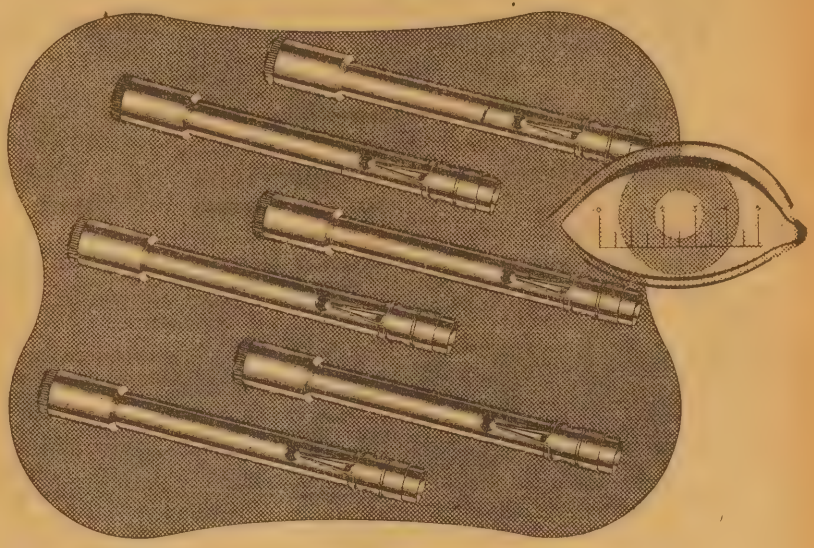
---

AMALGAMATED WIRELESS has been commissioned to supply and install a frequency modulation radio network for the Maritime Services Board.

This system will comprise a central station housed in the board's new head office building, which is to be occupied next month, and 12 mobile stations.

The network will provide a two-way radio telephone service between the board's offices and its vessels engaged on harbor duties.


# PERSONAL PROTECTION!



Workers in the nuclear physics and radiography fields cannot afford to be without some form of radiation monitor to determine the total dosage received over any period.

The Kershaw Pocket Dosimeter is the ideal unit — a personal monitor for indicating the integrated doses of Gamma and Hard X-ray radiation received by an individual over any period.

In the shape of a fountain pen measuring less than five inches in length it is conveniently clipped in the pocket. To determine the accumulated radiation exposure the Dosimeter is held toward a light source and an integral graticule, calibrated to a maximum of 500 milliroentgens, accurately indicates the total dose. A quartz fibre, which moves across the graticule in response to the dose received, is initially set to zero by a charging unit.

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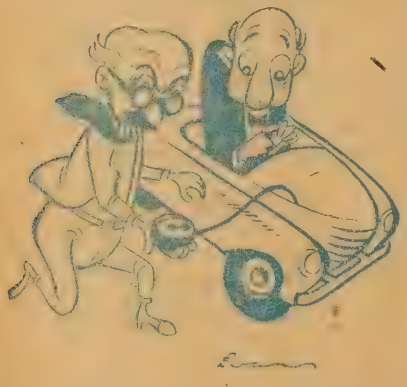
# Here's your answer, Tom!

After answering all the queries put to us by Tom over the years we are beginning to feel like technical versions of the "quiz kids." His questions this month are no less varied than usual and go from cathode ray oscilloscopes to car radio installations, with questions about superhets and about FM thrown in.

HIS first question gives our artist an opportunity to draw a dreadful pun. We hope it isn't as painfun for Tom as it was for us!

**I recently acquired an oscilloscope and am now in the process of learning to use it. Could you please tell me what the terminal marked "External Sync." is used for?**

As you know, Tom, the oscilloscope has an inbuilt oscillator for the purpose of deflecting the spot harizontally. The frequency of this oscil-



lator can be varied at will by means of "Sweep Frequency" controls. Usually, there are two of the latter, one for coarse and one for fine adjustment.

When the frequency of the sweep oscillator is the same as, or a multiple or submultiple of, the signal being applied to the vertical deflecting plates, there will be a stationary pattern on the screen. If the sweep frequency varies the pattern will move, the amount of movement depending on the difference between the sweep frequency and the multiple or submultiple you have chosen.

## DRIFT

In the above we are assuming that you are looking at some steady recurrent signal. The 50 cycle power mains would be an example.

Should the frequency of the sweep oscillator drift slightly or possibly the signal vary in frequency the pattern will drift. In practice it is extremely difficult to keep the two together for any length of time unless some special system is adopted.

By taking a small portion on the signal from the vertical deflecting plates and applying it to the sweep oscillator, it is possible to make the sweep frequency synchronise with the signal. This is the normal state of affairs for ordinary everyday use of an oscilloscope.

However, there are occasions when it is desired to synchronise the sweep oscillator with some external source of signal. For example, you may wish to measure the frequency of the signal applied to the vertical plates.

In this case you could synchronise the sweep oscillator with an accurate signal generator and then vary the frequency of the generator until you obtain a stationary pattern. There are other uses for the external synchronisation which will occur to you as you become more familiar with the instrument.

All this talk about external "sync" reminds our artist of his early days in the country where all the plumbing was external. He says it's no joke having to get up early on a winter's morning to a tubful of cold water!

**Could you please describe briefly the difference between AM, PM and FM, and which is the most popular? Also, could an ordinary household receiver cover the three of them?**

AM, or amplitude modulation, is the system in which the amplitude or strength of the carrier wave is varied in sympathy with the audio signal generated by the microphone. With this system the carrier wave stays on the same frequency all the time.

It is the system used by all the stations on the ordinary broadcast band in this country, also by most shortwave broadcast stations and most amateurs.

## RECENT ADDITION

FM, or frequency modulation, is a more recent addition to broadcasting. With this system the amplitude of the carrier wave remains constant but its frequency varies from a nominal or centre frequency in proportion to the strength of the signal from the microphone.

For example, a weak signal from the microphone will cause the frequency of the carrier to vary slightly either side of the centre frequency. A strong signal from the microphone will cause the carrier to shift a long way from the centre frequency. The engineer designing the equipment decides on the degree of frequency shift that is permissible in a particular system and designs his sending and receiving equipment accordingly.

A large amount of frequency shift is desirable in the case of high quality sound broadcasting, while in the case of commercial communication channels, for example, it is important to conserve space in the frequency spectrum and a small frequency deviation may be used.

When frequency modulation was first introduced the main advantages claimed for it were its noise-reducing properties, but it also has the advantage of requiring simpler modulation equipment. In many cases an FM transmitter can be designed to consume less power than an equally effective AM transmitter.

## CRITICAL ADJUSTMENT

On the other hand, a number of the components in an FM receiver must be able to maintain a critical adjustment if it is to perform satisfactorily.

Whether it be for broadcasting or commercial communication the use of FM is almost exclusively confined to VHF and UHF because it requires a greater portion of the frequency spectrum than AM.

PM, or phase modulation, is similar to FM in that the strength of the carrier remains constant. However, the frequency deviation increases not only in proportion to the strength of

the modulating signal but also in proportion to its frequency. It has the noise-reducing properties and the other advantages of the FM system but tends to require a greater portion of the spectrum.

A special type of detector circuit is required for FM or PM. This detector is designed to be sensitive to changes in frequency but insensitive to changes in amplitude. The main component of the common types of electrical interference consists of

an amplitude variation which accounts for the noise-reducing properties of an FM or PM system.

The detector requirements and the fact that the systems mostly operate on VHF make it unlikely that you will ever hear FM on an ordinary household receiver. However, some radio amateurs do carry out experiments from time to time on the higher frequency amateur bands. If you do hear one of these stations operating you will be able to obtain reception of sorts by tuning your receiver a little either side of the centre frequency.

**What causes the volume of the sound to vary and also clicking noises in a car radio when the car is going along?**

The two things may be due to different causes, Tom.

A high speed clicking sound that varies with the speed of the engine is most likely radiation from the ignition system. A conscientious technician installing the radio would take steps to remove this together with any generator interference that may have been present. However, various types of interference often develop when the radio has been in the car for some time.

Sometimes an electric petrol gauge will cause interference when the level of the petrol in the tank alters with the motion of the car.

Normally, there is a microscopic film of grease separating the wheel and axle, but when this breaks down it can cause clicks in the radio. The moral is to keep your car well greased.

Fading could be caused by a faulty component in the set or faulty wiring in which case the advice of a competent technician is desirable. However, it may also be connected with the inability of the automatic volume control system of the set to make up completely for the widely varying signal strength conditions. In travelling along a highway, the car may be between shielding cliffs at one particular instant while at another instant it may be on the top of a mountain completely in the clear.

## FADING

A slight amount of fading is to be expected, even in the best of sets. However, if the performance of the set has changed radically a new check up would seem to be indicated.

Sometimes it is very difficult to find faults in car radio sets, particularly when they are apparent only when the car is moving. For example, clicks due to faulty bonding between adjacent parts of the body may only be apparent when the car is moving over an uneven road. Much depeneds on the skill and experience of the installation technician.

In the above case, if he isn't shrewd enough to find the trouble, he may be forced to run alongside the car with a bonding tester!

**Would you please tell me if the impedance of the primary of a power transformer remains the same for any condition of the secondary? In other words, is the primary more or less electrically independent of the secondary?**

Nothing could be farther from the truth, Tom. As a matter of fact, the primary and secondaries of a power transformer are very intimately connected, or should be if the manufacturer has done his job properly.

No one has ever succeeded in making a perfect power transformer, but many of them are so good that their deficiencies can be overlooked in most cases. For the purposes of the discussion we will imagine that the power transformer under consideration is perfect in every respect.

If the primary winding is connected to the power mains and the secondary winding left open circuit no energy will be drawn from the power mains. When the transformer is first connected to the supply a current flows and in so doing creates a magnetic field in the iron core of the transformer. However, when the current reverses its direction of flow in the next portion of the cycle, the energy stored in the magnetic field is returned to the power mains.

## TRANSFORMER "BANK"

The transformer behaves something like a bank which borrows money from one lot of people in order to lend it to another lot of people. Of course, the bank is not a perfectly efficient device, because it has to pay its staff, &c., and to do this it has to charge interest.

The "interest" in the case of a power transformer is a small portion of the electrical energy which is wasted in the form of heat in the successive changing of the electrical energy to magnetic energy and back to electrical energy.

If you connect a resistor across the secondary of the power transformer, some of the energy of the magnetic field will be used up in causing the current to flow through the secondary winding and the resistor. The primary winding will then not be able to "pay back" all the energy it "borrows" from the power mains. The energy dissipated in the resistor, therefore, actually comes from the power mains.

The great advantage of a transformer is that it can have the secondary windings so arranged that they will deliver a high voltage at low current or a low voltage at high current, depending on your requirements. Transformers will not work with a direct current applied. This is the reason for alternating currents being so widely used in power distribution circuits.

**How does a tone-control work?**

The details depend on the type of tone-control, Tom, but the general principles remain the same.

The idea of a tone-control is to alter the volume of one portion of the reproduced audio frequency spectrum *relative* to the others. For example, many broadcast receivers are equipped with a "top cut" tone-control. This type of control attenuates the treble notes in relation to the bass.

It depends for its operation on the fact that the reactance of a condenser is lower at high frequencies than at low frequencies. Thus, a condenser may be connected across the circuit in such a way that the low frequencies are able to pass unhindered, while the high frequencies are attenuated. The frequency at which the attenuation begins depends on the value of the condenser and also the resistance of the circuit.

**(Continued on Page 91)**


# RADIO ACCESSORIES

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# Let's Buy An Argument

**Everyone likes a mystery—a situation which intrigues and provokes and stimulates. Who can resist the lure of a swinging hammock and a cleverly written "Whodunnit?" Radio men, being what they are, prefer technical mysteries, even though the specially clever ones might know the answer already.**

by W. N. Williams

NOW high frequency bias, as used for tape recording, is something of a mystery.

It certainly is for the beginner, who has to be satisfied with the explanation that the bias "kinda agitates the particles and makes them easier to magnetise."

The more enlightened types quote references and draw hysteresis loops and hope they know the answer.

But unfortunately for their peace of mind, the still more enlightened types quibble with accepted explanations and suggest that they don't go far enough.

They'd be pleased to explain if it wasn't for morning tea and other important matters!

But, coming back to the ordinary "we-makem-and-sellem" level, one hears statements to the effect that bias current and frequency isn't at all critical. That, with care, values for each can be found that will permit good recording on any likely kind of tape.

Contrariwise, equivalent bods. can be found who will assert just as positively that you can't find a "universal" bias setting, acceptable for all brands of tape. That, inevitably, some tapes will be encountered which will distort horribly unless proper adjustment is made to the bias.

And, of course, there is the conflicting evidence of commercial recorders. Some have provision for varying the bias, others have not.

What is the reason for this conflict of thought? Is it bound up with faulty observation, or self-delusion or pressure from over-active sales departments? Or are there factors which are not yet fully appreciated by those who make the equipment? Let's have a closer look at the problem.

It isn't hard to demonstrate in the first instance that the bias current and frequency do influence the final result, notably the overall recording level, the frequency response and the distortion content.

It can be shown ,too, that tapes vary in respect to optimum recording bias and that, if the bias is wrong, the recording will suffer. The contentious aspect appears to be—by how much?

## HOW SERIOUS?

Is the deterioration likely to be relatively minor or is it likely to lead to large changes in level, large variations in frequency response and to gross distortion?

If we might add a query of our own, it would be this: Are there factors in the design of record-replay heads which might accentuate the need for optimum bias? In other words, factors which make choice of bias and the matching of tape more significant in some cases than in others.

If there are such factors, then they would account for the diversity of opinions one hears expressed on the subject. They would explain, too, why some dislike tapes which other folk are perfectly happy to use.

To lend point to these observations, I have reproduced some curves derived by the manufacturers of American "Scotch" tape and using an apparently typical commercial recorder. The actual quantities will not apply in detail to other combinations of tapes and heads, but the curves do illustrate the kind of things that happen.

Figure 1 shows the effect on both level and frequency response of varying the bias current, using a black oxide paper tape. For the purpose of the test, the audio current was maintained constant at all frequencies and the bias held to 40 Kc.

At the low frequency end, the 4:1 difference in bias current makes very little difference to the level — a matter of 1 or 2 db. At 1000 cps. the difference is still quite small but take a look at 6000 cps! The gap between curves 1 and 2 has opened to some 5 db., while curve 3 is 20 db. down and headed for a virtual cut-off.

Figure 2 shows the same kind of curves for No. 111 tape, which has a red oxide on a plastic base. The curves differ somewhat in level and shape from those of figure 1, but they have much the same story to tell.

By coincidence or otherwise, curve 1 of figure 1 approximates closely curve 2 of figure 2, both being drawn for approximately 3 ampere-

turns of bias. Yet the two coatings are quite different in character.

Before jumping to conclusions, however, have a look at figure 3, showing response and output curves for No. 112 "Scotch" tape. The outstanding point is that the optimum recording condition occurs with less than half the bias current required by the other two.

With its optimum bias, the signal level from the 112 tape is down only slightly but bump the bias current up to 3 ampere-turns and the difference becomes very noticeable indeed.

## OTHER TAPES?

It is reasonable to assume that still wider variations would be shown between equivalent curves taken on tapes from different manufacturers and different countries.

All of which leads logically to the observation that it is unscientific just to run tapes through a machine and draw bald conclusions, that tape A is more sensitive than tape B, or that C has a better frequency response than D. It may well be that the bias current in the recorder happens to suit tapes A and C better than it does tapes B and D.

Change to a different machine, or alter the bias current and the story might be considerably modified or even reversed in special cases.

Argumentative types, please note!

Figure 4 shows the distortion, measured in terms of the third harmonic, resulting from a variation in bias and using the black oxide paper tape. The 3 ampere-turn figure is selected as optimum, with 6 ampere-turns almost as good. Markedly higher or lower values of bias make a noticeable difference to distortion level.

Equivalent curves for the red-oxide tape (figure 5) are rather more erratic in shape but the rise in distortion with excessive or insufficient bias is still obvious.

Looking at them, the designer might logically determine to use 3 ampere-turns of bias—or its equivalent in another head—and set the channel compensation to cope with the expected frequency response. But what of the other tape?

## TAPE DISTORTS!

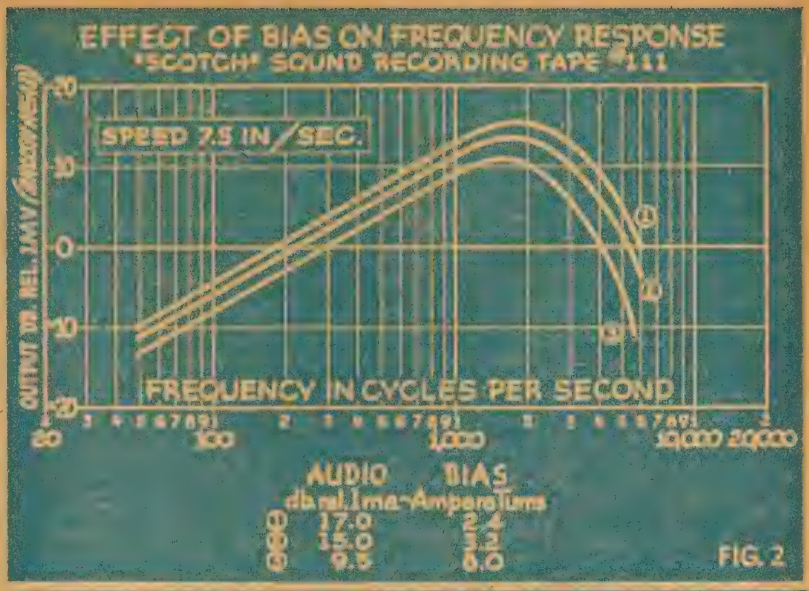
The curves of figure 6 are confused somewhat by the different ordinates and by the necessity for making allowance for its lowered sensitivity. But it might easily be branded as "a tape that distorts" if attempts were made to run it at the same playback level and with the same bias as the other two.

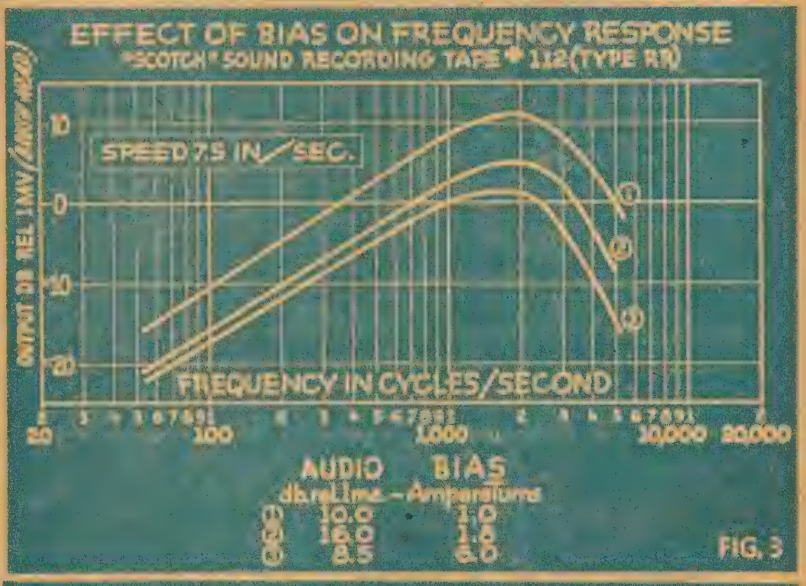
But lower the recording level and the bias current, and turn up the playback gain, and the reproduction may be perfectly satisfactoy.

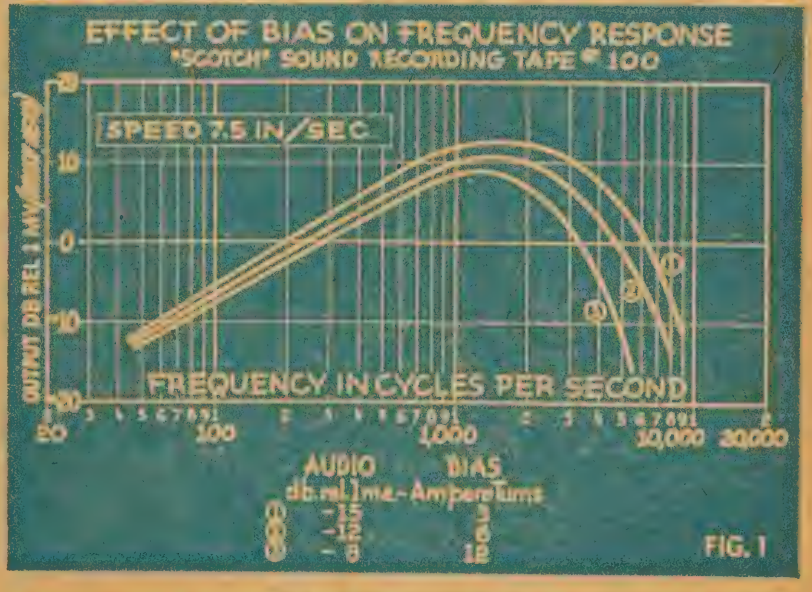
On a professional basis, curves of this nature are most important and every effort is warranted to get the bias current just right for each individual head and each class of tape.

The engineer, concerned with making a tape master for a disc, is not likely to quibble about a few hours' test procedure if it will yield a two-to-one reduction in third harmonic.

Conversely, in the popular price field for tape recorders, one can assume that the users don't' have access to harmonic analysers nor are they concerned with recording pro-



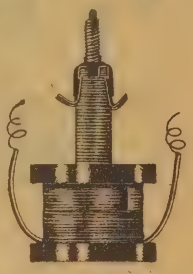




A typical set of curves showing output and response for three kinds of tape and differing bias current though a typical head.

# "Q-PLUS" Whistle-Filter

## CHOKE—W.F.C.I.

**Size**—⅞" diam. x 1⅛" high (to chassis)



**Inductance** — 100 MH
Minimum— 95 MH
Maximum— 115 MH
(Adjusted by variable iron core)

**Mounting** — Push fit into 5/16" hole — speed nut type.

**Winding Q at 10,000 Cps.—40.**
**Current Carrying Capacity** DC 15 MA.

### General Description and Remarks

*Wound on iron dust bobbin which reduces stray fields. Turns may be easily removed or even added to obtain other values.*

*Designed primarily for Radio & Hobbies Whistle Filter circuits and tone control unit, etc. See October, 1952, Radio & Hobbies.*

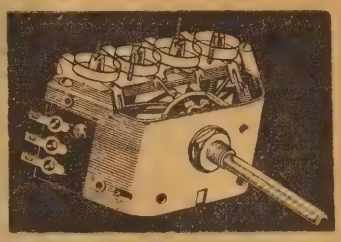
**R. W. STEANE & CO. PTY. LTD., AUBURN, VIC.**

# "Q-PLUS" D.W. Brackets

PAGE 1

## MINIATURE SINGLE STAGE B/C—S/W TUNING UNITS

**SIZE**
Height, 1⅜"
Width, 3⅛"
Depth, 2⅜"



**TUNING RANGE**
535—1630 K/CS
+
5.9—18 M/CS

**Tuning Capacity**—25—445 uufd. inc. strays.

### CONVERTER TYPES

Four types are available and to obtain best results it is essential that the correct one be used.
DW4—6J8, 1A7, 6A8, etc.
DW6—1R5
DW5—ECH33/35, X61M, 6AE8, 6AN7
DW7—6BE6, 6SA7

### MAIN FEATURES:

*Carbonyl iron cores on all coils Sw and B/C.*
*All trimmers and adjustable cores accessible from one side.*
*4000 pf and 430 pf padder—condensers inbuilt—mica type.*
*Oak type wave change switch.*
*Narrowed neck construction to allow dial spindle and volume control to be closely fitted.*
*Polystyrene Short Wave formers, polythene covered windings for absolute minimum losses.*
*Litz wound broadcast coils.*

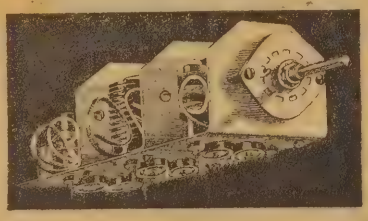
**See page two for further information**

# "Q-PLUS" D.W.R. Brackets

PAGE 1

## Miniature R.F. STAGE Tuning Units B/C—S.W.—GRAMO.

**SIZE**
Height, 2⅛"
Width, 2⅝"
Depth, 5⅜"



**TUNING RANGE.**
535—1630 Kcs
+
5.9—18 M/CS (16—50M—)
or
7.2—23 M/CS (13—42M—)

**Tuning Capacity**—25—445 uufd. Inc. strays.

### CONVERTER TYPES

DW4—6J8, 6A8, 1A7, etc., B/C + 5.9—18 M/CS only.
DW5—6AN7, 6AE8, ECH33/35, X61M, etc.
DW6—1R5, B/C + 5.9—18 M/CS only.
DW7—6BE6, 6SA7.

### MAIN FEATURES:

*Carbonyl high frequency cores on all bands.*
*All trimmers and adjustable cores accessible from one side.*
*Built in mica padder condensers—4000 pf + 430 pf.*
*Oak type wave change switches.*
*Polystyrene short wave coils wound with polythene.*
*Covered wire for absolute minimum losses.*
*Litz wound broadcast coils.*
*3 sets switch contacts for dial light and Gramo switching B+ opening, etc.*
*DW6 type requires external bias source.*

*See page two for further information.*

# "Q-PLUS" D.W. & D.W.R. Brackets

PAGE 2

### GRID CURRENT DETAILS.

If converter section is operating correctly, oscillator grid current should be approximately as follows:—

| | SW HF end | LF end | BC HF end | BC LF end |
|---|---|---|---|---|
| DW4 | .3 ma | .45 ma | .37 ma | .25 ma |
| DW5 | .22 ma | .20 ma | .26 ma | .20 ma |
| DW6 | .4 ma | .1 ma | .32 ma | .20 ma |
| DW7 | .2 ma | .2 ma | .43 ma. | .36 ma |

## ALIGNMENT

The alignment of these units is of extreme importance as otherwise the full performance of the unit cannot possibly be obtained.

High gain I.F. transformers are desirable and it is assumed that these have been aligned. A Q Plus spot frequency alignment oscillator is a very useful article for this work and is available for only 75/- plus sales tax. Full instructions for I.F. alignment are included with that unit.

First see that dial calibration is designed to match the gang type and frequency range, particularly on S.W. band, then set dial pointer to the end of the calibrations when tuning condenser is in maximum and minimum positions respectively. BROADCAST Set Oscillator at 600 Kcs or thereabouts and move the dial until signal is heard — of course make sure that the switch contacts are in the B/C position. Each bracket is prealigned and no trouble should be encountered in this. Adjust B/C oscillator core until signal occurs when dial is at 600 Kcs. Next adjust B/C Aerial core for maximum output. Swing dial to 1600 Kcs and set generator to identical frequency. Rock dail until signal is heard, next adjust B/C oscillator trimmer and move dial until signal is maximum at 1600 Kcs Then adjust B/C Aerial trimmer for maximum output. Repeat low frequency alignment procedure and tidy up High Frequency end again. N.B. AVC should be shorted if set has same.

SHORT WAVE. Switch to S/W position on bracket. Set generator to 6.00 M/cs if 16-50 M or 7.5 M/CS if 13-42M and dial to similar setting. Adjust S.W. oscillator core for maximum signal. Swing dial and generator to 17' M/CS or 22 M/CS and use S/W oscillator trimmer to set dial position and S/W aerial trimmer to maximum output. Usually at the High Frequency end of the S/W band two spots will be found at which the generator will be heard — use the lower frequency one for alignment purposes.

In the case of the R.F. Brackets the procedure is identical with the addition of having the R.F. coil to align; this is done after the oscillator section has been aligned. It is necessary to rock the dial slowly around the alignment point as the trimmer is adjusted, as otherwise pulling effects will interfere with true alignment conditions. This is most prevalent at the H.F. end.

SEE PAGE 3 FOR FURTHER DETAILS.

grams under studio conditions and with hi-fi microphones. Therefore, the difference between 1 and 2 pc distortion is likely to be completely lost on them.

The problem becomes one of arranging matters (or trying to) so that the bias is at a suitable compromise figure for the classes of tape likely to be used in the machine. The ability to use a variety of tapes would presumably constitute a good sales feature.

Customers might be warned that certain tapes are unsuitable for use in the machine but don't let's mislead people by telling them confidentially that "the machine is all right but the tape is no good."

Sales types, please note!

## UNKNOWN FACTORS

But tape enthusiasts could be excused for looking askance at figures 1-6 and observing rather acidly:

(1.) "I don't know how many turns are on the head."

(2.) "I can't measure bias current."

(3.) "I don't know how my head compares in magnetic efficiency with the Brush head."

(4.) "I have no means of measuring percentages of harmonic distortion."

For folk in such a quandary, two rules of thumb have been evolved which may help in getting the bias somewhere near optimum:

**(1.) Use a bias frequency which is five times (or more) the highest audio frequency you expect to record. Since the top frequency is not likely to exceed 9 or 10 Kc at 7½in per sec. the bias frequency lands at about 50 Kc.**

By using a higher bias (and, therefore, erase) frequency, there is a vague chance of picking up extra treble response but, at the same time, erase problems are likely to be multiplied out of all proportion, particularly with black oxide tapes.

There may be another difficulty also, which I'll mention later.

**(2.) Select a bias amplitude which is just about equal to that required for maximum output from the tape.**

The procedure is to record an approximate 1000-cycle note at a moderate level on a specimen of the tape. Vary the amount of bias at the record head and measure the output on playback for each setting, using some kind of output meter.

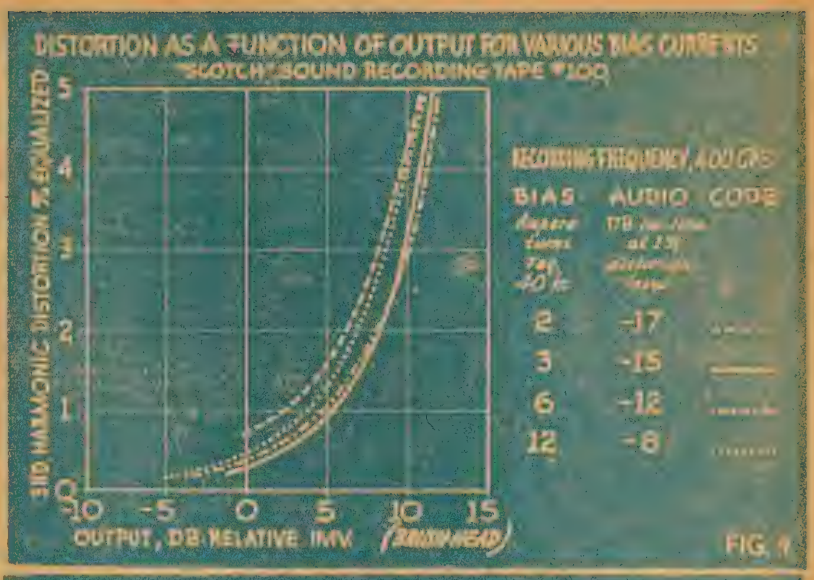
## OPTIMUM BIAS

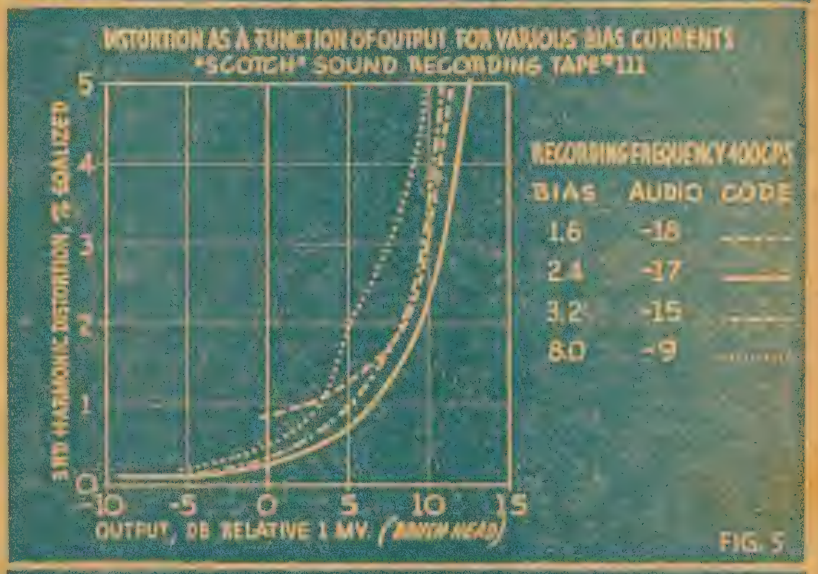
The optimum bias voltage (or current) can then be reckoned to be equal to or a trifle more than that required to give maximum output.

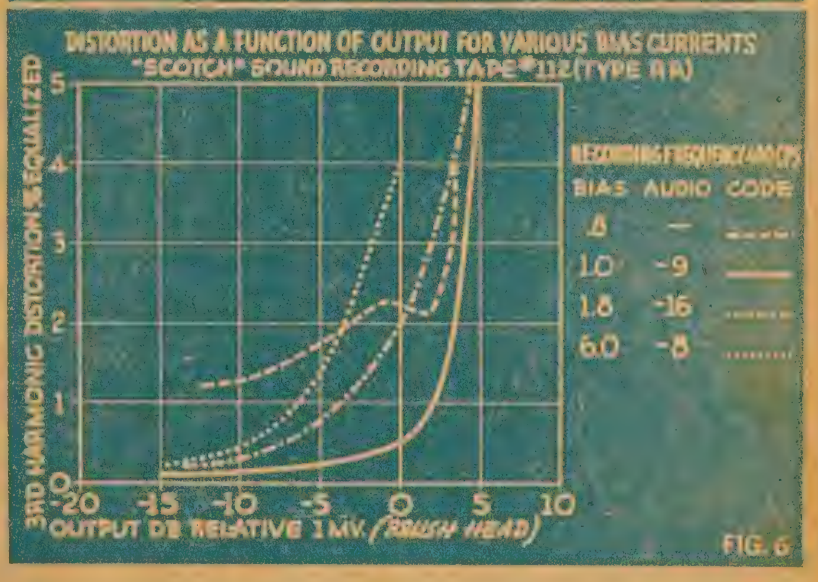
To be more precise, the "Scotch" people recommend the use of the "maximum output" bias for popular priced machines using high frequency erase, ranging up to 50 pc over "maximum output" bias for machines using DC erase. In the latter the higher bias helps to minimise the extra noise on the tape.

Summing up the whole position the "Scotch" people observe in general that the bias setting is not particularly critical but that excessive bias leads to high frequency losses. Conversely, insufficient bias produces distortion and poor signal-to-noise ratio.

Now that's fine as a general state-





DISTORTION AS A FUNCTION OF OUTPUT FOR VARIOUS BIAS CURRENTS
"SCOTCH" SOUND RECORDING TAPE *112 (TYPE 11A)
3RD HARMONIC DISTORTION % EQUALIZED
OUTPUT DB RELATIVE 1 MV.
BIAS AUDIO CODE
.8 —
1.0 -9
1.8 -16
6.0 -8
FIG. 6

These curves inter-relate bias current and distortion for the three classes of tape referred to in figures 1, 2 and 3.

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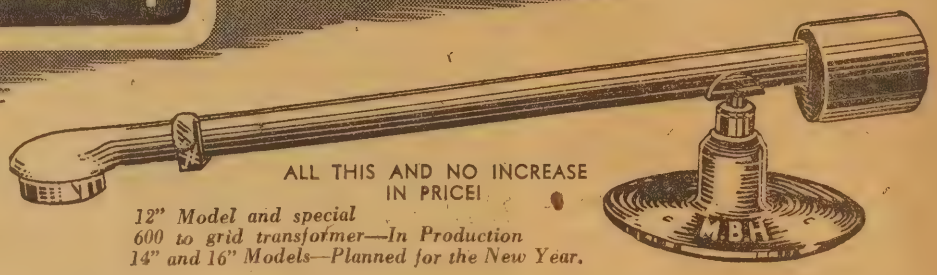
★ High Vertical and Lateral Compliance

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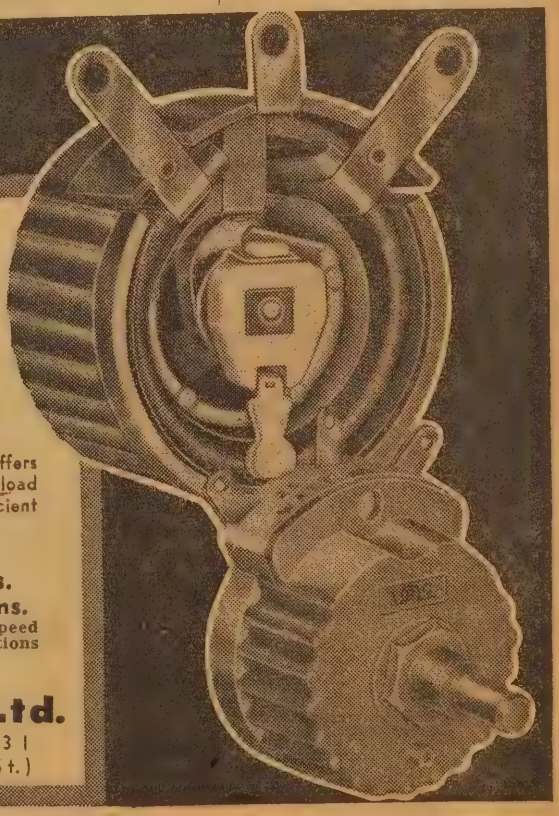

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ment but, to get back to the "mystery" theme, it's the order of the effects that intrigues me and the way they appear to vary in individual cases. In my travels, I've seen or heard about four classes of heads:

(1) Those which record and play back with mediocre frequency response, but seemingly on any old tape you like to bring along.

(2) Those credited with better frequency response but which "distort" unless the bias is near to optimum.

(3) Heads which are prone to distortion anyhow.

(4) Heads which aren't critical of bias and which still give an excellent response.

## SPECULATION

Observation of these heads started me on a technical "witch hunt" and produced a theory which might not be altogether ridiculous. It's probably not original either, but at least I haven't heard it expounded elsewhere.

It could be reticence; it could be ignorance.

The majority of low-priced recorders, these days, use combined record/playback heads. In an effort to get the best possible playback characteristics, the manufacturers have been bending over backward to achieve a smaller effective gap length, the figure being reduced from something like .001in to nearer a quarter of this figure.

Now that may be fine for playback purposes, but what about recording? Is a short gap going to prejudice the performance in this respect?

The circumstances are so very different. A playback head operates with low signal flux, it is not concerned with bias, but it is subject to the gap effect.

Conversely, a recording head operates with high signal flux, it must handle the bias frequency and it is not subject to gap effect. The pattern on the tape is not a function of the flux across the gap, but the flux at the "trailing" edge of the recording field.

Looking back through text books, one is reminded that, during recording, penetration of the flux lines into the magnetic tape varies with frequency; whereas low frequency flux penetrate quite deeply, high frequency flux may affect only the surface layer close to the pole face.

But, by the same token, what happens to the bias flux? The lines must surely tend to be restricted even more, the only thing to force them out being the sheer intensity of the bias current.

## BIAS OR NOT?

Shortening the gap would presumably accentuate the effect. So also would increasing the bias frequency!

If the bias flux do not penetrate the tape layer as deeply as ALL the audio frequencies being recorded, then the outer layers of the tape coating will be affected by the audio without an adequate simultaneous bias. And audio which is recorded without adequate bias can be very, very distressing.

And, likewise, the kind of distortion I've heard from questionable heads is just that—very, very distressing!

Well then, giving all that in, why not simply increase the bias current and do the job by sheer brute force?

Maybe you can't do that. Maybe, once the pole tips are saturated magnetically, you can't increase the flux across the gap, no matter how much current you push through the windings.

Maybe you could get the gap so fine that you simply couldn't link the bias flux effectively with the tape coating.

Or perhaps you could use a fine gap if the pole faces were differently shaped to avoid self-shunting. Maybe there's an optimum relationship that needs to be preserved between gap length : depth : width. (How true!")

And anyhow, why does bias amplitude so markedly affect distortion? Is it simply that insufficient bias fails to "grow" an adequate hysteresis loop in the coating as a whole, or does it fail to bias properly the remote surface of the coating.

The point I'm driving at is that you can't afford to record on and playback regions in the magnetic layer which are not adequately biased. And this might conceivably happen if the gap is wrongly proportioned or if there too great a discrepancy between the bias and the top audio frequency.

You see I'm now in the completely nebulous realm of speculation without an atom of measured data at this stage to support or quash the ideas. But if the ideas should be correct, they would explain:

(1) Why some older machines with wide-gap heads and low frequency oscillators don't seem to be very fussy about bias amplitude or tapes (Easy way out!)

(2) Why heads with finer gaps are more touchy about bias and tapes, though their playback response is markedly better (Trying hard!).

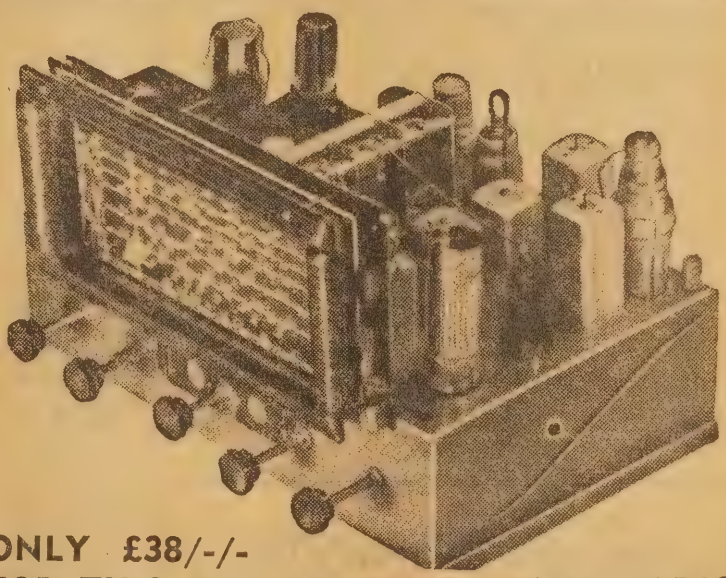
(3) Why some heads distort, no matter what you do with the bias (Sorry, try again!).

(4) Why some heads manage to be tolerant of bias and tapes and still give good playback response (Oh, I say, well done, sir!).

In other words, the diverse opinions about bias, tapes, &c., may not stem from self-delusion or faulty observation or sales departments or any other dreadful thing. It may simply be the result of interdependance of tapes, and heads and bias to a degree that has not been fully appreciated.

The tapes, we buy ready made. The bias, we can adjust easily enough. All we have to do now is to find out all about head design.

And that, I think, is just about where we came in. I seem to have written a lot, but whether I've really said very much remains to be seen. Anyhow, it makes good stuff to argue about.

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| Wts | Primary Impedance | Secondary Impedance | Retail Price | Special Application | Code No. |
|---|---|---|---|---|---|
| 10 | 5000, 2500 SE | 12.5, 8, 2.3 | 64/3 | | OP-1 |
| 10 | 5000, 2500 SE | 5, 2.7 | 65/4 | | OP-33 |
| 10 | 5500 SE | 3.7 | 72/1 | | OP-41 |
| 10 | 30,000 20,000 14,000 10,000, 7000, 5000, 2500 PP | 2.3 | 65/2 | Universal Test Loud Speaker | OP-53 |
| 10 | 5000, 2500 SE | 15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2. | 72/1 | | OP-54 |
| 10 | 5000, 2500 SE | 15. | 65/4 | | OP-39 |
| 10 | 10,000 PP | 15, 8.4, 2.3. | 72/1 | 5W Cath Amplifier | OP-85 |
| 10 | 7000 PP | Any ONE of following impedances—15, 12.5, 8.4, 2.3, 2. | 72/1 | 9W Cath Amplifier | OP-92 |
| 15 | 5000 PP | 12.5, 8, 2.3. | 99/1 | | OP-2 |
| 15 | 6600 PP | 12.5, 8, 2.3. | 99/1 | | OP-3 |
| 15 | 10,000 PP | 12.5, 8, 2.3. | 99/1 | | OP-4 |
| 15 | 10,000, 6600, 5000 PP | 12.5, 8, 2.3. | 99/1 | | OP-5 |
| 15 | 5000 PP | 15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2. | 105/3 | | OP-55 |
| 15 | 6600 PP | 15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2. | 105/6 | | OP-56 |
| 15 | 10,000 PP | 15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2. | 105/6 | | OP-57 |
| 15 | 10,000, 6600, 5000 PP | 15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2. | 106/8 | | OP-58 |
| 25 | 10,000, 6600, 5000 PP | 15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2. | 133/10 | | OP-59 |
| 32 | 10,000, 6600, 5000 PP | 15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2. | 171/- | | OP-60 |
| 60 | 3800 PP | 17.6 | 166/8 | | OP-36 |
| 60 | 3800 PP | 100, 75, 50, 25, 10, 5, 2. | 195/5 | | OP-61 |

## P.A. RANGE 50-8000 cps. Output to Line

| Wts | Primary Impedance | Secondary Impedance | Retail Price | Special Application | Code No. |
|---|---|---|---|---|---|
| 10 | 5000, 2500 SE | 500 | 64/3 | | OP1A |
| 10 | 5000, 2500 SE | 500, 250, 125 | 74/3 | | OP-44 |
| 15 | 5000 PP | 500, 250, 125 | 99/1 | | OP-6 |
| 15 | 6600 PP | 500, 250, 125 | 99/1 | | OP-7 |
| 15 | 1000 PP | 500, 250, 125 | 99/1 | | OP-8 |
| 15 | 10,000 PP | 500, 250, 160, 125, 100, 83.5, 71.5, 62.5, 55.5, 50 | 117/4 | | OP-8M |
| 15 | 10,000, 6600, 5000 PP | 500, 250, 126 | 99/1 | | OP-9 |
| 15 | 5000 PP | 600, 300, 200, 150, 130, 100, 75, 50 | 114/10 | | OP-34 |
| 15 | 8000 PP | 600, 300, 120, 60, 30 | 199/10 | | OP-50 |
| 25 | 5000 PP | 500, 250, 125 | 119/7 | | OP-10 |
| 25 | 6600 PP | 500, 250, 126 | 119/7 | | OP-11 |
| 25 | 10,000 PP | 500, 250, 125 | 119/7 | | OP-12 |

## P.A. RANGE Cont.

| Wts | Primary Impedance | Secondary Impedance | Price Retail | Special Application | Code No. |
|---|---|---|---|---|---|
| 25 | 10,000, 6600, 5000 PP | 500, 250, 125 | 119/7 | | OP-13 |
| 25 | 10,000 6600 PP | 500, 4000, 8.4, 2.2 | 164/1 | Cutting and Playback Amplifier | OP-35 |
| 25 | 6600 PP | 600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5,3.6,2.7 | 199/10 | | OP-38 |
| 32 | 5000 PP | 500, 250, 125 | 144/11 | | OP-14 |
| 32 | 6600 PP | 500, 250, 125 | 144/11 | | OP-15 |
| 32 | 6600 PP | 500, 250, 166, 125, 100, 83. 5,71.5, 62.5, 55.5, 50 | 148/9 | | OP-15M |
| 32 | 10,000 PP | 500, 250, 125 | 144/11 | | OP-16 |
| 32 | 10,000, 6600, 5000 PP | 500, 250, 125 | 144/11 | | OP-17 |
| 32 | 6600 PP | 140, 70 | 171/- | | OP-48 |
| 60 | 3800 PP | 500, 250, 125 | 168/8 | | OP-18 |
| 60 | 3800 PP | 100, 75, 50, 10, 5, 2 | 195/5 | | OP-61 |
| 80 | 6400 PP | 500, 250, 125 | 207/- | | OP-37 |
| 105 | 8800,6000 PP | 500 | 299/- | | OP-49 |
| 150 | 11,600 8400 PP | 500 250, 166, 125 | 384/1 | | OP-20 |

## HI-FI RANGE 30-15000 cps. Output to Voice Coil

| Wts | Primary Impedance | Secondary Impedance | Price Retail | Special Application | Code No. |
|---|---|---|---|---|---|
| 5 | 5000 SE | Any ONE of the following impedances 15, 12.5, 8.4, 6.5, 2.1 | 67/6 | 4W Baby Playmaster | OP-24 |
| 10 | 3250 SE | 12.5, 8.4, 2.3 | 101/2 | R & H Vox Major | OP-23 |
| 10 | 5000 SE | 2 | 92/- | For Rola 120x Speaker | OP-113 |
| 10 | 5000 PP | 2 | 92/- | For Rola 120x Speaker | OP-117 |
| 10 | 6600 PP | 2 | 92/- | For Rola 120x Speaker | OP-119 |
| 10 | 8000 PP | 2 | 92/- | For Rola 120x Speaker | OP-118 |
| 10 | 10,000 PP | 2 | 92/- | For Rola 120x Speaker | OP-112 |
| 15 | 5000 PP | 12.5, 8, 2.3 | 147/2 | | OP-19A |
| 15 | 10,000 PP | 15, 3.75 | 152/11 | 10W Playmaster | OP-63 |
| 15 | 10,000 PP | 12.5, 3.125 | 152/11 | | OP-64 |
| 15 | 10,000 PP | 8.4, 2.1 | 152/11 | | OP-65 |
| 20 | 4500 PP | 15.5, 12.5, 8.6, 2.7, 2 | 134/4 | 15 & 32W Cathamplifiers | OP-51 |

## Output to line

| Wts | Primary Impedance | Secondary Impedance | Price Retail | Special Application | Code No. |
|---|---|---|---|---|---|
| 10 | 3250 SE | 500, 250, 125 | 101/2 | | OP-22 |
| 15 | 5000 PP | 500, 250, 125 | 147/2 | | OP-19B |
| 15 | 10,000 PP | 500, 125 | 152/11 | | OP-62 |

## SPECIAL HI-FI RANGE 20-30,000 cps.

| Wts | Primary Impedance | Secondary Impedance | Price Retail | Special Application | Code No. |
|---|---|---|---|---|---|
| 15 | 10,000 PP | 8.4, 2.1 | 180/11 | For Williamson Amp. | OP25/8.4 |
| 15 | 10,000 PP | 10, 2.5 | 180/11 | For Williamson Amp. | OP25/10 |
| 15 | 10,000 PP | 12, 3 | 180/11 | For Williamson Amp. | OP25/12 |
| 15 | 10,000 PP | 15, 3.75 | 180/11 | For Williamson Amp. | OP25/15 |
| 15 | 10,000 PP | 16, 4 | 180/11 | For Williamson Amp. | OP25/16 |
| 15 | 10,000 PP | 40, 10 | 180/11 | For Williamson Amp. | OP25/40 |
| 15 | 10,000 PP | 250, 62.5 | 180/11 | For Williamson Amp. | OP25/250 |
| 15 | 10,000 PP | 500, 125 | 180/11 | For Williamson Amp. | OP25/500 |
| 15 | 5000 PP | 8.4, 3.7 | 192/5 | | OP-66 |
| 15 | 5000 PP | 15, 6.5 | 192/5 | | OP-67 |

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# FROM THE SERVICEMAN WHO TELLS

**Of all the factors which contribute to the degeneration of radio components there seems little doubt that corrosion due to moisture is one of the most important. Just how big a part it plays is not fully realised, at least by the average serviceman (including yours truly) until some outstanding case pesents itself to bring the point home.**

SUCH a case occurred to me recently and it set me wondering just how many components find their way into the garbage can because of this influence. The result of these reminiscences may prove interesting to readers who may have been prompted to ask, "Why did that component fail?"

Remember how, a few years ago, a consistent source of failure was the speaker output transformer, particularly in battery-operated receivers? While not due entirely to the presence of moisture, there is little doubt that these failures would not have occurred with anything like the frequency they did if moisture could have been completely excluded from them.

## CHEMICAL ACTION

Main cause of the trouble was the presence of minute quantities of chemical salts in the paper used to separate the adjacent layers of the windings. Ideally, such paper should be chemically neutral but, in practice, it is virtually impossible to achieve this completely, despite a lot of research.

When the moisture in the air combines with these chemicals, which are often corrosive, the first step has been taken toward the ultimate failure of the winding. Tiny pinholes in the enamel insulation, inevitable in any wire, allow the corrosive moisture to reach the copper and commence its job of destruction.

Even unaided, this is sufficient to bring about the eventual failure of the wire, but the condition is aggravated by the potential difference between the winding, which is carrying the HT voltage, and the speaker frame, which is normally connected to the chassis.

This results in a minute flow of current through the paper, or, rather, the impurities of it, and produce electrolysis, or chemical action by the application of voltage. Under these conditions it is not long before the fine copper wire is completely destroyed and the winding becomes open circuited.

I mentioned that this trouble was more prevalent in battery receivers, and the simple explanation for this was that the HT voltage was applied to the winding continuously, whether the set was being used or not, and the destruction of the winding was, therefore, taking place for 24 hours of the day.

The ultimate solution to this problem was ingenious and is now standard practice with most speaker manufacturers. Part of the story was the complete sealing of the winding in a metal case filled with a wax or bitumen compound designed to reduce the ingress of moisture to an absolute minimum.

## INSULATED CORE

But the really ingenious part was the elimination of the potential difference between the winding and the core, by the simple procedure of connecting the core to one end of the winding, thus putting it at the same potential as the winding.

Naturally this meant that the core had to be insulated from the external metal case and that there would be a potential difference between these two parts, but this was easily achieved and was no disadvantage because any electrolysis here would not affect either part adversely.

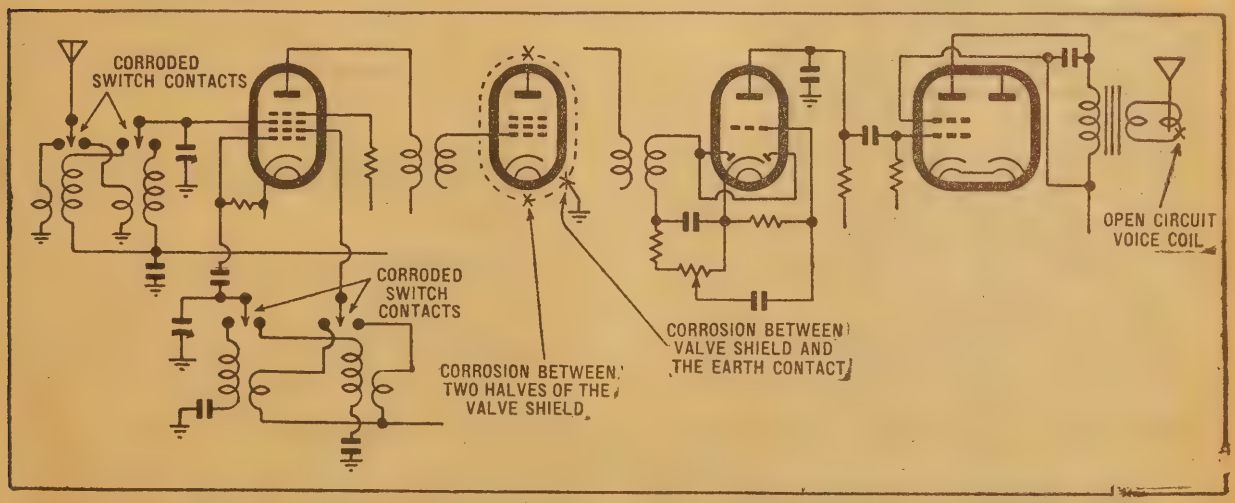
As a result, one battle against moisture has been won, and an open circuit in a modern speaker transformer is comparatively rare. As an added precaution, most battery sets, these days, have a two-pole on-off switch which breaks both the filament and the HT circuit.

The story behind the failure of the ordinary paper condenser is much the same; the presence of small amounts of impurities in the paper dielectric, the penetration of moisture in spite of the application of protective waxes, and the potential difference between the two sides of the paper, all contribute to electrolysis and ultimate breakdown.

## OPERATING VOLTAGE

Thus the voltage at which a condenser is operated has a considerable effect on its expectation of life and one which is being operated continuously at, or near, its maximum rating is more likely to fail in a given time than one which is much under-rated. It also explains why a condenser can be given a flash test considerably in excess of the recommended working voltage.

It must be realised that no one appreciates these problems more than the condenser manufacturer, in fact, he has been responsible for the research which brought such


CORRODED SWITCH CONTACTS
CORRODED SWITCH CONTACTS
CORROSION BETWEEN TWO HALVES OF THE VALVE SHIELD
CORROSION BETWEEN VALVE SHIELD AND THE EARTH CONTACT
OPEN CIRCUIT VOICE COIL

A circuit showing the three major faults in a receiver which had been stored in a damp location. Corrosion of the wave change switch contacts rendered the set completely inoperative, while a corroded earth connection on the IF valve shield caused hopeless instability. Finally, the speaker voice coil became open circuit.

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★ **SPEED CHANGE:** By external knob marked for 33 1/3, 45, 78 R.P.M., and employing the "Rotocam" method — simple and absolutely reliable.

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facts to light. However, there is very little that he can do except to keep such impurities to a reasonable minimum consistent with sensible economics.

In practice this works out reasonably well, resulting in a reasonably priced component which, in the normal way, can be expected to have a life equal to most of the other components in the set. In all probability, most of the condensers will still be giving good service when the chassis is finally discarded.

Of course, a small percentage fail after various periods of operation but, taking an overall view, it must be admitted that the manufacturer at least has the moisture problem under control, even if it is not yet completely beaten.

In the early days of the superhet, when the autodyne was a standard circuit, moisture was a serious brob-lem, as any old hand will testify. Fundamentally the autodyne was a poor oscillator, both from the way it connected into circuit and from its high initial bias.

For this reason any reduction in "Q" of the oscillator coil, such as might be caused by the absorption of moisture from a humid atmosphere, was sufficient to render the oscillator circuit inoperative.

## OSCILLATOR FAILURE

Since the feedback was always lowest at the low frequency end of the band this was always the first part to become inoperative, the oscillator coming good at a point toward the high frequency end, depending on the amount of moisture absorbed and the general efficiency of the circuit in the first place.

Thus it was that any prolonged spell of wet weather would result in a flock of sets to the serviceman, all suffering from the same complaint, namely, failure to receive stations over portions of the low frequency end of the band.

The most effective cure was to dry the coil so that it was restored to its former efficiency and, preferably, take some steps to see that it was protected against further effects of moisture. My own pet method of attacking this problem was to heat a tin of parrafin wax on the kitchen stove, to the annoyance of the rest of the household and, when it was hot, to dip the coil into it.

The result would be a violent boiling action as the moisture was vaporised, and this would continue until all the moisture was removed. When the bubbles ceased to rise the coil would be removed, allowed to cool and fitted back into the chassis. It invariabley cured the trouble and, as far as I could learn, was also very effective in preventing a re-currence.

## IMPREGNATION

Nowadays, of course, coil manufacturers have achieved a high standard of efficiency in the matter of impregnation designed to protect not only the "Q" of the coil but also the possibility of the fine wires being damaged by moisture and corrosion.

Other effects of moisture which have caused trouble in the past have been the growth of fungus on almost any part of the set made from vegetable products, such as coil formers, cotton-covered hookup wire, paper insulation in various components, &c. Sooner or later it will cause a complete breakdown of the parts concerned.

This is not a serious problem in temperate climates, though I have known local sets to produce a crop of fine powdery fungus on cotton covered hookup wire, but it can be very serious in the tropics. For this reason, sets which are intended for use in areas of high humidity need to be very carefully designed if they are to give satisfactory service.

The advent of plastics has done much to overcome these problems and its use for wire insulation, coil formers, and insulators in general, has now become almost standard practice. The advantage of these substances is that they are extremely stable chemically and do not absorb moisture, and it is likely that they will play an increasing part in overcoming the problems of moisture in electronic apparatus.

Another corrosive effect which I have noticed, but which I am not able to explain fully, is the formation of a fine white powder on pot. covers made from mild steel and which appear to be cadmium plated. The effect is not serious in an electrical sense but it is most unpleasant to look at and I always try to clean it up whenever I find it. My usual approach is to clean up the corrosive patches with a rag and then apply a thin film of fine oil (a small camel hair brush is very suitable) to retard further trouble.

## OIL OR LACQUER

In the event of the pot. being in a location where dust is likely to be collected it might not be advisable to use oil and a smear of clear lacquer might be more appropriate. As I say, I have not much idea as to the actual cause and it may be that some reader can supply the answer.

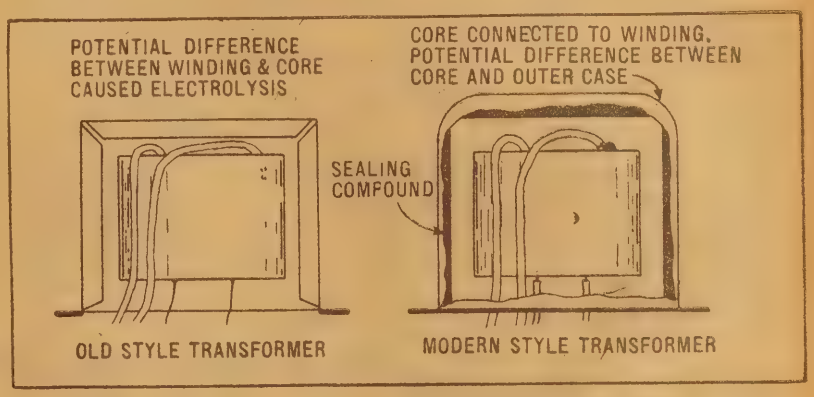
Gang condensers have also suffered from the effects of corrosion in the past, particularly when, during the war, it was necessay to use substitute materials. Present-day practice is to use aluminium and this appears to be perfectly satisfactory, providing it is of a sufficiently high standard of purity.

However, zinc was used extensively during the war years and there are plenty of sets still in operation which use these gangs. Many of the early ones appeared to have no protective coating of any kind and corroded readily in the presence of moisture and small impurities in the air. These spots of corrosion were frequently thick enough to short to an adjacent plate, causing noise and intermittent reception as the plates were rotated.

Later models were plated and this seemed to be an improvement at the time. Unfortunatly, while it eliminated the corrosion problem, it introduced another one, because the plating ultimately lifted, providing thin slivers of metal to short to adjecent plates.

A standard method of curing such troubles, at least temporarily, is to "burn out" the shorts. This is done by connecting a moderate voltage between the fixed and moving plates and then rotating the gang. The result is a brilliant display of fireworks wherever there is a short and, in most cases, the shorts will burn themselves out in a few seconds. The more persistant ones will require some assistance, such as a little cleaning, but this not hard once the position of the trouble is known.

Suitable voltage can be obtained from a 45 volt "B" battery or from the HT supply of the set, but it is important to include some resistance in the circuit to limit the current flow to a reasonable figure in the event of a dead short. This is most important with the higher voltages.


POTENTIAL DIFFERENCE BETWEEN WINDING & CORE CAUSED ELECTROLYSIS
CORE CONNECTED TO WINDING. POTENTIAL DIFFERENCE BETWEEN CORE AND OUTER CASE
SEALING COMPOUND
OLD STYLE TRANSFORMER
MODERN STYLE TRANSFORMER

Showing the difference between the old and the new type speaker transformers. In the new type electrolysis occurs between the core and outer case, and the damage to either is negligible.

Having glanced over what I have just written I realise that what started out to be a brief reflection has turned into a major discussion and I have, as yet, said nothing about the set which prompted all this.

It was a four valve dual wave mantel set, featuring a 32L7G combined ouptput valve and rectifier, together with the more conventional 6J8, 6U7, and 6B6.

As far as I could make out it had failed for some reason (it had so many faults in it that it was hard to say which had occured first, and the owner could not remember) and had been relegated to a damp corner of a garage or storeroom where it had lain almost forgotten for a couple of years. Apparently the owner had only ever used it as a second set and, for various reasons, had decided not to have it repaired when it first failed.

## BAD CORROSION

My first impression on removing the chassis from the cabinet was not a favorable one. The chassis and speaker frame were badly rusted, the speaker cone was warped and light pressure with the fingers confirmed that the voice coil was scraping the pole pieces. In addition, many of the non-ferrous metal parts were covered with green verdigris and the whole thing was a sorry sight.

I switched it on and checked the

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|---|---|---|---|---|---|
| 1682- H | 220-230-240 | 285 | 60 | 6.3v-2A; 5v-2A | 34/- |
| 1636-3H | 200-220-230-240 | 300 | 80 | 2 x 6.3v-2A; 5v-3A | 42/9 |
| 1332-3H | 200-220-230-240 | 300 | 120 | 2 x 6.3v-2A; 5v-3A | 53/3 |
| 1356-3H | 200-220-230-240 | 400 | 150 | 5v-3A; 2.5v-5A; 6.3v-4A | 70/- |
| 1380-3H | 200-220-230-240 | 450 | 208 | 2 x 6.3v-2A; 5v-3A | 102/6 |
| 1371-8 | 200-220-230-240 | 500-600-750-850-1000 | 300 | | 150/- |
| 1400-19 | 200-220-230-240 | 565-500-425 | 250 | 2 x 6.3v-3A; 2 x 2.5v-3A, 5v-3A | 110/- |
| 1643-23 | 200 or 230 or 240 | — | — | 6.3v TAP 5v-2A (500v insul) | 17/6 |
| 1525-21 | 200-230-240 | — | — | 2.5v-10A (1000v insul) | 47/6 |
| 1305-22 | 200-220-230-240 | — | — | 2.5v-10A (3000v insul) | 75/- |

## FILTER CHOKES

Swinging Chokes Marked *

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|---|---|---|---|---|---|---|
| 975-23 | 20 | 15 | 60 | 320 | 500 | 16/6 |
| 973-9 | 30 | 20 | 80 | 370 | 500 | 33/6 |
| 973-21 | 30 | 20 | 80 | 370 | 500 | 26/9 |
| 1012-1A | 35 | 20 | 120 | 430 | 1000 | 35/3 |
| 967-1A | 35 | 20 | 150 | 200 | 1000 | 46/- |
| 956-1A | 30 | 20 | 200 | 160 | 1000 | 57/9 |
| 1011-1A | 30 | 15 | 250 | 160 | 1000 | 59/6 |
| *983-1A | 25 | 20/5 | 30/300 | 90 | 1000 | 65/6 |
| 996-1A | 15 | 10 | 300 | 60 | 1000 | 62/6 |

## AUDIO OUTPUT TRANSFORMERS

* Response Includes Correction due to Negative Feedback ** For Use With Rola 12-OX Speaker

| TYPE AND MOUNTING | IMPEDANCE—OHMS PRIMARY | IMPEDANCE—OHMS SECONDARY | FREQ. RESPONSE DB+— | FREQ. RESPONSE CPS | RATING WATTS | TYPICAL APPLICATION | PRICE |
|---|---|---|---|---|---|---|---|
| 893-23 | 5000, 7000 | 2, 3.7, 8, 12.5 | 1 | *40-15,000 | 5 | SINGLE 6V6G, 6AQ5 ETC, TO VC | 28/3 |
| 894-23 | 500 | 2, 3.7, 8, 12.5 | 2 | 50-10,000 | 5 | LINE TO VOICE COIL | 26/3 |
| 900-22 | 2500, 5000 | 2, 3.7, 8, 12.5, 15 | 1 | *40-15,000 | 15 | SINGLE 807, EL34 ETC. TO VC | 57/6 |
| 896-9 | 8000, 10,000 | 2, 3.7, 8, 12.5, 15 | 1 | 30-15,000 | 15 | PP 6V6G's A OR AB1 TO VC | 62/6 |
| 897-9 | 8000, 10,000 | 100, 125, 166, 250, 500 | 1 | 30-15,000 | 15 | PP 6V6G's A OR AB1 TO LINE | 62/6 |
| 763-9 | 3000, 5000 | 2, 3.7, 8, 12.5, 15 | 1 | 40-20,000 | 15 | PP 2A3's A OR AB1 TO VC | 62/6 |
| 809-26 | 500 | 2, 3.7, 8, 12.5, 15 | 1 | 50-20,000 | 15 | LINE TO VOICE COIL | 42/6 |
| 870-26 | 10,000 | 2 or 8 | 1 | *20-20,000 | 6** | PP 6V6G's OR 807's AS TRIODES | 57/6 |
| 871-9 | 10,000 | 2 or 8 | 1 | *20-20,000 | 12 | PP 6V6G's OR 807's AS TRIODES | 81/- |
| 872-9 | 10,000 | 3.7 or 15 | 1 | *20-20,000 | 12 | PP 6V6G's OR 807's AS TRIODES | 81/- |
| 891-22 | 6600 | 83, 100, 125, 166, 250, 500 | 1 | 50-12,000 | 35 | PP 807's AB1 TO LINE | 82/6 |
| 892-22 | 3200 | 50, 62, 83, 125, 250, 500 | 1 | 50-12,000 | 55 | PP 807's AB2 TO LINE | 97/- |

## INPUT TO GRID TRANSFORMERS

| | | | | |
|---|---|---|---|---|
| 511-10 | 50-100,000 OHMS | MUMETAL CORE | 30-10,000 CPS | 65/- |
| 509-10 | 200-100,000 OHMS | MUMETAL CORE | 30-10,000 CPS | 65/- |
| 502-10 | 600-100,000 OHMS | MUMETAL CORE | 30-10,000 CPS | 65/- |
| 563-6 | 600-60,000 OHMS | STALLOY CORE | 200-5000 CPS | 42/6 |

## INTERSTAGE TRANSFORMERS

| | | | | | |
|---|---|---|---|---|---|
| 518-6 | 20,000 TO 20,000 OHMS | SE OR PP | RADIOMETAL CORE | 1:1 RATIO 30-10,000 CPS | 69/- |
| 519-6 | 20,000 TO 80,000 OHMS | SE OR PP | RADIOMETAL CORE | 1:2 RATIO 30-10,000 CPS | 69/- |
| 620-6 | 20,000 TO 180,000 OHMS | SINGLE ENDED | RADIOMETAL CORE | 1:3 RATIO 30-10,000 CPS | 69/- |

## DRIVER TRANSFORMERS

| | | |
|---|---|---|
| 545-9 | SE 4000 TO PP AB2 GRIDS 1.6:1. PRIM. TO ½ SEC. RATIO 50-10,000 CPS 5 WATTS | 57/6 |
| 588-6 | SE OR PP 5000 TO PP 807's CLASS B. 200-5000 CPS 5 WATTS | 52/6 |

## LOW LEVEL OUTPUT TO LINE TRANSFORMERS

| | | | |
|---|---|---|---|
| 705-6 | PP 30,000-600 OHMS | RADIOMETAL CORE. MAX. LEVEL 250 MW. 30-10,000CPS | 69/- |
| 712-6 | PP 30,000-200 OHMS | RADIOMETAL CORE. MAX. LEVEL 250 MW. 30-10,000CPS | 69/- |
| 710-6 | SE OR PP 20,000-600 OHMS | RADIOMETAL CORE. MAX. LEVEL 250 MW. 30-10,000CPS | 69/- |
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— 8: Open steel clamps. Terminal strip prim. & sec.
—19: Horizontal 6" x 5" cast cover. Sub-terminal panel.
26—23: Open steel brackets. Terminal strips.
6—10— 9: Diecast case with solder terminals.
—21: Open steel clamps. Terminal strips.
—22: Open steel clamps. Terminal strips.
—1A: Vertical steel louvred covers & leads.

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HT voltage which finally settled down to about 125 volts, a normal figure for sets of this type since the output valve is designed for 117 volt operation. The audio end of the set seemed to be functioning quite normally and the speaker gave forth a healthy burp when the finger was placed on the audio grid.

However, this was the only part of the set which was working correctly because, as soon as the volume control was advanced, the only sound which could be heard was a violent motor-boating.

This was eventually traced to the AVC circuit and from there to the wave change switch. I had not noticed this component very closely before but now I realised that it was in a really bad way. Every contact was covered in green verdigris and even a visual inspection was sufficient to show that many of them were not functioning properly.

A meter check confirmed that there was an open circuit in the signal grid circuit of the 6J8, no voltage on the oscillator plate and a very erratic circuit in the oscillator grid — all due to the faulty switch. It occurred to me that a general clean up with carbon tetrachloride, plus some careful adjustment of the contacts, might be all that was needed to put the switch back into working order.

## RUINED SWITCH

Alas, I had badly underestimated the effects of the corrosion. I had barely commenced to apply pressure to one of the contacts with the blade of a screwdriver when it broke off near the rivet. I touched another, with the same result, and was finally forced to realise that every contact was in a similar condition.

The exact cause of the corrosion is rather hard to explain. At first I thought that it may have been due to an unwise choice of flux, but the fact that some spare contacts which had never been soldered were in exactly the same condition caused me to reject the theory, and I can only conclude that it was due to poor-quality plating or even worse storage conditions than I had originally visualised.

Anyway, whatever the cause, the switch was obviously completely useless. This presented something of a problem, because the owner had intimated that he did not wish to spend a great deal on the set and merely wanted something with which to listen to the races on a Saturday afternoon while working in his garage.

On this basis I decided that he would probably be perfectly satisfied if the set functioned satisfactorily as a broadcast set only, and that it would be very much cheaper to wire it this way permanently than to replace and rewire the switch. As a temporary measure I shifted the broadcast wires over to the common lugs on the switch and tried again.

## BAD HETERODYNES

The motor-boating had now vanished but things were still far from right. Certainly there was some evidence of signals, but they consisted of violent heterodynes at each station setting, behind which could be heard very faint modulation. I checked all voltages, by-pass condensers, &c., which would be likely to cause such instability without finding anything which would even give me a lead to the trouble.

Finally I tracked it as far as the IF stage and found that there was a marked response to the presence of a hand around the valve and decided that the valve shield might not be properly earthed. Connecting it to a nearby IF can with a screwdriver made a considerable improvement and I removed the valve and shield for closer examination.

The shield was one of the form-fitting variety, made in two halves and held together with metal ring around the centre. The earth connection was made by what is known as a cathode clip; a small metal clip which fits over the spigot on an octal base and connects with either pin No. 1, normally blank, or pin No. 8, normally the cathode which is either earthed directly or through a condenser. In this case pin No. 1 was used and this pin on the socket was connected directly to the chassis.

The cathode clip made connection to the shield by being simply clamped under the base of it and it was obvious that this was the cause of the trouble because, once again, the metal was covered with a thick coating of verdigris. A spot of flux and a hot soldering iron quickly removed any unwanted resistance at this point and I plugged the valve back in and switched on. Result: Dead silence.

I soon established that the entire audio system was dead and then that the speaker had failed. I immediately visualised an open speaker transformer primary but this proved to be in order and the trouble was finally traced to an open circuit voice coil, obviously another victim of corrosion.

## INSTABILITY

Since I had anticipated that the speaker would have to be returned to the makers for a new cone, this was not a serious calamity, and I continued my interrupted test of the front half of the set by substituting the voice coil of the bench speaker.

The performance was now considerably improved and the AVC action was sufficient to render the set stable on local stations, but it was still hopelessly unstable on all other stations. The effect was once more traced to the IF valve and it was found that small movements of the valve shield would sometimes effect a cure. Likewise, it was possible to reduce the effect by placing the hand around the valve and the general effect was still one of insufficient shielding.

More careful observation showed that additional shielding, as with the hand, was more effective on one side of the valve than the other, and this was at first thought to be due to the placing of the grid lead. However, when this theory proved to be false it was noticed that the side of the valve which was still sensitive was opposite the side where the shield had been soldered to the cathode clip.

This gave me a lead and I forced a screwdriver blade between the two halves of the valve shield, whereupon the oscillation ceased completely. It was now clear what was happening. The half of the valve shield remote from the cathode clip was not earthed, in spite of the metal ring which held the two halves together. Once again, corrosion seemed to be the only explanation, although, in this case, there was no visible evidence of it.

A short length of tinned copper wire and two soldered joints removed any possibility of the trouble occurring again and the set then functioned more or less normally.

## EXIT SHORT WAVES!

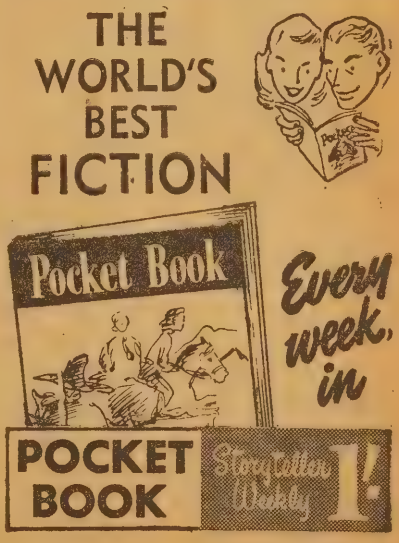
I then contacted the owner and explained the situation, with particular reference to the dual-wave switch, and the possibility that the cost of replacing the switch would not be justified if the short-wave section was not likely to be needed. He quite agreed with this suggestion, and, in fact, seemed to have forgotten that the set ever had a shortwave section. My personal opinion is that this section of the circuit had never been used since it left the dealers.

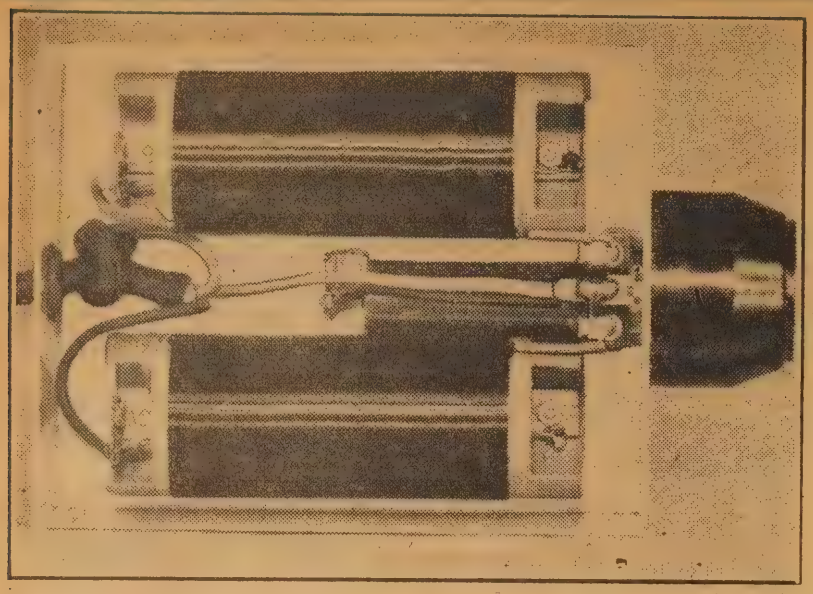
Next step was to dismantle the speaker from the chassis and return it to the makers for a new cone and voice coil assembly. In the meantime I rewired the coil connections to make it a permanent broadcast arrangement, went over the remaining valve shields and treated them in the same manner as the IF stage, and adjusted the dial mechanism.

## DIAL REPAIR

This latter was in rather a bad way, the cord having stretched, and the metal runner for the pointer carriage being badly rusted. Fortunately, modern practice is to use brass for these parts, but this set had apparently been made when brass was not generally available due to wartime shortages. With the cord adjusted and the rust removed the dial worked smoothly and a smear of light oil was applied to the moving parts to reduce the risk of further rusting without, I hoped, too much possibility of the oil "gumming up" the works at a later date.

Finally, the speaker, completely reconditioned by the makers, was fitted back on to the chassis and the set given a final overhaul and alignment before being returned to the owner. I advised him to try to avoid damp storage locations for the set in future, and pointed out that much of the cost of repairs was due to adverse storage conditions rather than the original fault which had caused the set to fail.



Here is the filter unit with the cover removed. The radio set or appliance plugs into the 3-pin socket at the right. The flex at the left carries a 3-pin plug to plug into the house wiring power outlet. Full constructional details are given in the text.

# HOW TO MAKE A LINE FILTER

**Here is a simple unit which could well help you to battle with the problem of electrical interference to radio programs. There are no installation worries—it simply plugs in between the radio set and the power socket. It is also effective in reducing interference caused by small electrical appliances.**

by Raymond Howe

INTERFERENCE to radio programs is an age-old problem, but there are effective ways in which to go about beating it. If you are prepared to wait your turn, you can obtain the assistance and advice of the appropriate department of the Postmaster General's Department in tracking down and possibly treating the source of interference.

You can, however, carry out some work yourself and in many cases it is possible to effect an improvement. One particular treatment in itself may not be sufficient, but when coupled with other methods, it can make the difference between good reception and poor reception.

It is necessary to realise that the power mains can pick up quite an appreciable level of program from a broadcast station. The capacitance to the set chassis of the primary winding of the power transformer causes signal currents to flow in the chassis because of its impedance to earth due to unavoidable length in the earth lead.

The aerial will have some capacitance to earth and hence there is a circuit through the aerial coil primary for these signals flowing in the set chassis.

Therefore, if the desired signals from the broadcast stations can arrive at the set input from the power mains as well as from the aerial, so can undesirable signals such as electrical interference.

It is easy to see that if temporary removal of the aerial from the set causes the interference to vanish or fall off in intensity, it does not necessarily infer that the interference is being picked up by the aerial.

This is where the line filter comes into the picture. Its function is to prevent any interference currents on the power mains from reaching the aerial coil primary.

This filter consists of a number af capacitors, which bypass the noise currents from the mains to earth, and a pair of RF chokes which raise the impedance at radio frequency between the set and the mains.

## SET TYPES

The effectiveness of the filter will depend upon the type of set. Used with a type which is designed to take advantage of the signal pick-up of the mains, it will reduce the signal level and the noise level by the same amount and you would be no better off.

In most sets, however, the filter will be found generally to be of some assistance in reducing interference if some or all of it is arriving via the power mains.

There will be many instances, of course, where interference on the mains will be radiated and picked up by the aerial. The only way to combat this, short of having the interference eliminated at its source, is to use an outside aerial as high as possible, well removed from the power mains or house wiring and, where practical, at right angles to it.

The "noise-reducing" type of aerial is useful here, too. It takes the form of a flat-top portion which picks up the desired signal well away from the interference and feeds it to the set through shielded or twisted lead-in passing through the "noisy" area. Impedance transformers are used between the aerial and the lead-in and the lead-in and the set.

On the other hand, if the source of interference, be it a sewing machine, mixer, drill, clippers, &c., is in your own home, a line filter could well be used between the apparatus and the power mains.

This would reduce the interference which would otherwise pass back along the power mains to be radiated and picked up by the aerial of the set. To be most effective, the length of flex between the filter and apparatus should be as short as possible.

Another possible use for the filter is in reduction of cross-modulation effects which can be experienced in areas of high signal strengths, particularly if the house wiring installation is not in a very serviceable condition.

The filter is housed in a metal case measuring 5¾in by 4½in by 2in deep. It is fitted with a lid which is secured in place with three self-tapping screws.

The case is easy to make up particularly if you use 18 or 20 gauge aluminium. The bending can be done in a 3 or 4in vise, clamping the aluminium between two pieces of straight wood at the bending mark when it extends appreciably beyond the jaws of the vise.

Alternatively, the case could be made up from ply-wood or other suitable timber. Light ply would probably need corner blocks to give the box some strength.

## CHOKE COILS

The coils are wound on 1¼in diameter former. Any sort of insulated former will do, even wood. We used cardboard mailing tube. It is quite satisfactory although it will not take too much rough handling during the winding and mounting process.

If you use a solid wooden former, you will need to rearrange the placement of the two .1 mfd capacitors. There is room for these between the coils if the power flex is fed into the box a little to one side of the end centre. Of course, the box could be made a little longer in such a case.

The two formers are cut to 4½in in length and two small holes are punched at about 5-8in from each end to anchor the ends of the winding. With cardboard formers, it is a good plan to tape the inside and outside of the ends with cellulose tape to add to its strength.

The winding on each coil consists of 24 gauge SWG or B & S enamelled copper wire close-wound to cover a length of about 3½in. The gauge size is not critical. For small loads such as a radio set, 26 gauge would be satisfactory.

It will take about 110ft of 24 SWG wire for both coils. A 4oz reel would be sufficient.

One way of going about winding the choke coils is to insert a screwdriver through the centre hole of the reel of wire and grasp the end of the driver in the vise. Pull off a reasonable length of wire and regrip the driver in the vise so that it prevents the reel of wire from turning.

Give the free wire a slight pull to remove bends and kinks. Do not stretch it too much as it will reduce the wire diameter and hence its current-handling capacity. Secure the end of the wire in the small holes leaving enough free for connection within the unit. Take up the strain in the wire and while holding the former at right angles to the wire, rotate it so that the wire winds on to the form as you slowly walk toward the reel held in the vise.

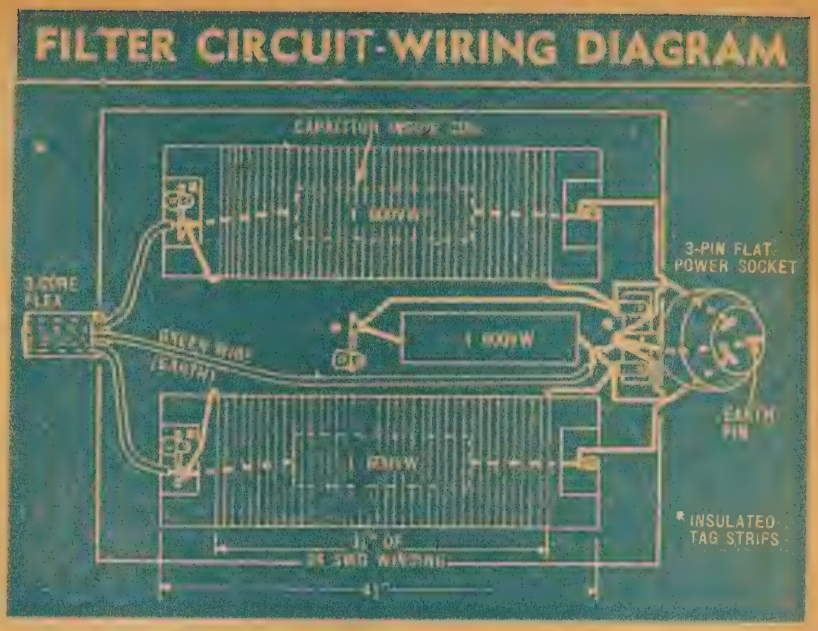
## COIL MOUNTING

As you will need to do this a few times, see that the partly-wound coil does not unwind itself as you feed out a new length of wire from the reel. When the coils are completed, run some coil dope or nail polish around the last few turns at each end to hold them in place.

The coils are mounted in the case with 1-8in countersunk head bolts of at least 5-8in in length. The bolts for each coil are spaced about 4in apart and just on an inch from the sides. Putting the heads up from underneath, secure the bolts to the bottom of the box with a washer and a nut. Run another nut down the bolt, place a 1-8in washer on that and adjust the position of the nut so that the coils will be about the same distance from the bottom of the case as they are from the sides. About 3-16 to ¼in will be satisfactory.

Punch holes in the formers to correspond with the securing bolt separation. Prepare a strip of 3-16in ply about ½in wide to slip over the bolts when the coil is in position. This braces the coil on its mounting. The top nuts screw down on this 3-ply after a solder lug has been placed on one bolt and a 2-tag mounting strip on the other.

You will notice that a portion of each former has been cut away at each end to allow easy access to the top nut for tightening. The wiring diagram shows that a .1 mfd capacitor is located inside of each coil.




The wiring of the filter is very simple. In some cases it may help to replace the .1 mfd capacitor across the 3-pin socket by two .1 mfd, one from each side of the mains to the case. See text for coil mounting details and important points to watch.

The capacitor pigtails are cut to length, insulating sleeving slipped on and the capacitor placed inside the coil before it is fitted into place. When the nuts are tightened, the capacitor is soldered to the solder lug at one end and the insulated tag of the mounting strip at the other.

A 2-tag mounting strip is secured to the bottom of the box at about the centre. It would be wise to drill the hole for this before mounting the coils in case you damage them with the drill.

A ¼in hole is drilled in that end of the box near the tag strips in the ends of the coil formers. Use a rubber grommet in this hole to prevent any chance of the case ultimately cutting into the flex.

Mount the 3-pin flat mounting, standard power outlet at the other end. Use the type which has a base diameter of 1⅞in. There is a larger type which has a base diameter of over 2in but this would overlap the end. Of course, you could make the box a little deeper if you want to.

Five holes are required for the 3-pin power outlet, two 1-8in holes for mounting and three 3-16in or ¼in holes for making connections to it.

A 3-tag mounting strip is secured under one of the mounting bolts. Bend the two outside insulated lugs downwards.

The circuit-wiring diagram gives a clear idea of every connection within the unit. Note that the earthed end of each of the .1 mfd capacitors inside the choke coils is connected to the common earthing point on the 3-tag mounting strip near the power outlet.

The 3-core power flex entering the box has the red and black leads connecting to the insulated lug of the 2-tag strips in the ends of the coils and the green lead connecting to the common earth point on the tag strip near the power outlet.

Note that the "earth" connection at the 3-pin plug and the power outlet is stamped in the moulding. Don't make a mistake here because it could be dangerous.

The case of the unit is thus connected to the earth system of the house power mains wiring. This is necessary for the satisfactory operation of the filter and also acts as a safeguard in case the mains wiring within the unit should "short" to the metal case.

If the mains wiring in your house is so out-dated as not to have an earth system, you should connect the case of the filter to a water pipe or to a large spike driven into moist earth. Remember that anything which has connection to the power mains can become lethal if care is not taken in the construction and installation.

The earth wire of the 3-core flex from the set to the line filter will earth the chassis of the set through the filter case back to the house wiring earth system.

You may find it necessary to provide the set chassis with a separate earth lead to a convenient water pipe. Keep this away from other power cords and the house wiring earth system to avoid induction of interference currents.

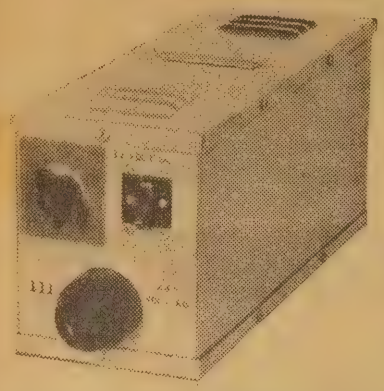
When the wiring is completed, make a lid to fit the box so that the unit will be completely enclosed. It can be made up in the same manner as the box with a 3-8in fold or lip. File a little of the lip away at one end so that it clears the power outlet.

### PARTS LIST

1 case 5¾in x 4½in x 2in deep with lid. 3 .1 mfd 600VW capacitors, 4oz reel 24 SWG enamelled copper wire, 1 small flat-mounting 3-pin power outlet, 1 3-pin plug, 9in, 1½in dia. former, 3 2-tag and 1 3 tag insulated mounting strips, 3-core power flex, scrap 3-ply, rubber grommet, spaghetti, solder lugs, solder, nuts and bolts, self-tapping screws.

# 240 VOLT AC 50 CYCLE INVERTERS

## FROM 12 VOLT BATTERY



**Suitable for loads up to 200 watts. Excellent frequency stability. Radio interference suppressed. 3 pin power outlet socket.**

## Price £28/10/-

Suitable for emergency lighting or in conjunction with Radios, Radiograms, Portable Amplifiers, Tape Recorders, Synchronous Motors. Completely shielded in metal case 5 x 6¼ x 13 inches. Unpacked weight 19lb. TRADE ENQUIRIES INVITED.

***Also available 32 Volt DC to 240 Volt AC 50 cycle at 100 Watts. Suitable for Radiograms. Price £28/10/-.***

### SANGAMO PRECISION TIMERS

48-hour jewelled movement. Can be run continuously or for one minute periods. Ideal for photographers, hobbyists, electrical flashes, signs, &c. **22/6**
Packing and Postage: NSW, 2/-; Interstate, 3/6.

### METERS

| | |
|---|---|
| 0-20mA DC 2½ inch Square Flush English Hobut. Brand new | 25/- |
| 0-10mA, DC 2 inch Round Flush | 17/6 |
| 0-.5 amp. RF Thermocouple, New | 12/6 |
| 0-3 Amp RF | 12/6 |
| 0-4 Amp RF Square | 12/6 |
| 0-30 mA 3 inch Round | 25/- |
| 0-20 Volt 2 inch Square | 20/- |
| 0-40 Volt 2 inch Square | 20/- |
| 0-20 Volt, 0-200 Volt Round | 20/- |

### 50-CYCLE A.C. AMMETERS

Range 0-14 Amps
Scale Size — 4in. Dia
Brand New

Price, each.

**55/-**

Packing and postage: N.S.W., 3/-; Interstate, 5/6.

### SELSYNS

Selsyns Motors 120v 50 c/s AC each
240v 50 c/s AC.
Per Pair ..... **£5**

### GENEMOTORS

Midget type as illustrated, input 28 volts, output 250 V at 60mA 35/-
TR1133 type, input 12 volts, output 300 volts at .24 amps, 150 volts at .01 amps. 6 volts at 5 amps. Filtered 90/-

### TR1133 TRANSCEIVERS

17 VALVE
Freq. Range 90-130 M/cs
12v DC input.
Supplied complete with dynamotor power supply, remote control box, plugs and cables and aerial Complete .. **£24/10/-**

### CONDENSERS

Paper Filter Oil Filled

| | | | | | |
|---|---|---|---|---|---|
| 8mfd | 1000vw | 25/- | 0.5 mfd | 3000vk | 1/6 |
| 5mfd | 350vw | 6/- | 0.25mfd | 3000vw | 7/6 |
| 2mfd | 2000vw | 20/- | 0.25mfd | 1000vw | 2/6 |
| 2mfd | 1800vw | 20/- | 0.1 mfd | 3500vw | 6/- |
| 2mfd | 1000vw | 12/6 | 0.1 mfd | 2000vw | 6/- |
| 1mfd | 2000vw | 10/- | 0.02mfd | 8000vw | 4/- |
| 1mfd | 1000vw | 6/- | 0.01mfd | 5000vw | 4/- |

### ELECTROLYTIC TYPES

| | | | | | |
|---|---|---|---|---|---|
| 1000mfd | 12PV | 3/- | 50mfd | 50PV | 2/- |
| 500mfd | 10PV | 3/- | | | |

**BUTTERFLY CONDENSERS**
Capacitance range 3-35 mircofarad. Size 1¼ x 2⅜ x 2¼ inches. Brass plates: Ultra high frequency insulation: ¼-inch shaft
Price ,each **8/6**
Packing and postage, NSW, 1/-; Q., T. and V., 1/6; WA, NT, 2/-.

### CONDENSER SPECIAL

New Midget Variable Condensers, 19 plate ceramic insulation.
PRICE **4/6**
Pack and postage, NSW, 1/-; Q., T. and V., 1/6; WA, NT, 2/-.

### DISPOSALS VALVES TESTED

| | | | |
|---|---|---|---|
| 6AC7 | 15/- | 12A6 | 10/- |
| 6H6GT | 7/6 | 12SG7 | 10/- |
| 6SH7 | 5/- | 12SK7 | 10/- |
| 6SH7-GT | 5/- | 12SR7 | 10/- |
| 717A | 10/- | CV6 | 5/- |
| 954 | 10/- | EA50 | 5/- |
| 956 | 12/6 | VT90 | |
| 9001 | 10/- | Micropup | 10/- |

### NEW VALVES

| | | | |
|---|---|---|---|
| 1K5 | 5/- | 7A6 | 10/- |
| 3Q4 | 12/6 | 7C7 | 11/6 |
| 3S4 | 12/6 | 879/2x2 | 15/- |
| 6C8G | 12/6 | 1293 | 11/6 |
| 6H6 | 10/- | 1294 | 11/6 |
| 6J5G | 10/- | VR54/EB34 | 5/- |
| 6SQ7 | 12/6 | VR65A | 3/9 |
| 6x5GT | 12/6 | EF50 | 9/- |
| 7193 | 3/6 | | |

### RELAYS

| | |
|---|---|
| American Midget Relays. 300 ohm coils DPST. PRICE | 6/6 |
| 12 and 24 volt 200 and 50 ohm DPST and 4PST Relays. BRAND NEW | 7/6 |
| Relay Units containing 3 Relays 28v DC 4PST with Locking Relay and also DPST Midget. PRICE | 15/- |
| 5.5 400 ohm coils DPDT. Price | 6/- |

### RECTIFIERS

| | |
|---|---|
| Full wave bridge copper oxide 100mA. | 4/6 |
| Full wave copper oxide 100mA. | 3/6 |
| Half wave, selenium, 5mA | 3/6 |

Postage 6d each.

### HIGH POWER I.R.C. RHEOSTATS

250 ohm, 25 watt.
10 ohm, 2½ amp; 25 ohm 1 amp. Price each. **12/6**
Packing and postage, 1/- each.

### D.C. GENERATORS

12v 750 watt. Ideal Homelighting Battery Charging, &c.
PRICE, £9/10/-, F.O.R.

### SPECIALS

| | |
|---|---|
| Dynamic Mike Inserts | 6/- |
| Carbon Mike Inserts | 2/6 |
| Bakelite Fuse Boxes | 4/6 |
| 5 Position Push Button Switches | 12/6 |
| 12v Cut Outs, 50 amps | 15/- |
| Head Phones, 4000 ohms | 28/- |
| Double Button Carbon Mikes | 7/6 |
| Throat Mikes | 5/- |
| Cutlas Hammer Switches | 2/6 |
| ARB Communication Receiver, 195kc-9 mcs | £18/10/- |
| P.M.G. Key Switches, 32 contact | 8/6 |
| Shielded Hook-up Wire 8d yard. | |
| Book! Radio Receiver Design by K. R. Sturley | 10/- |
| 3 gang AWA Condenser | 20/- |

### NEW DUCON ELECTROLYTIC CONDENSERS

8 uF 525 PV
PRICE **3/6**
Postage 6d each

Please add exchange to all cheques. Make money orders and postal notes payable to Lewisham Sorry no C.O.D

# ELECTRONIC EQUIPMENT CO.

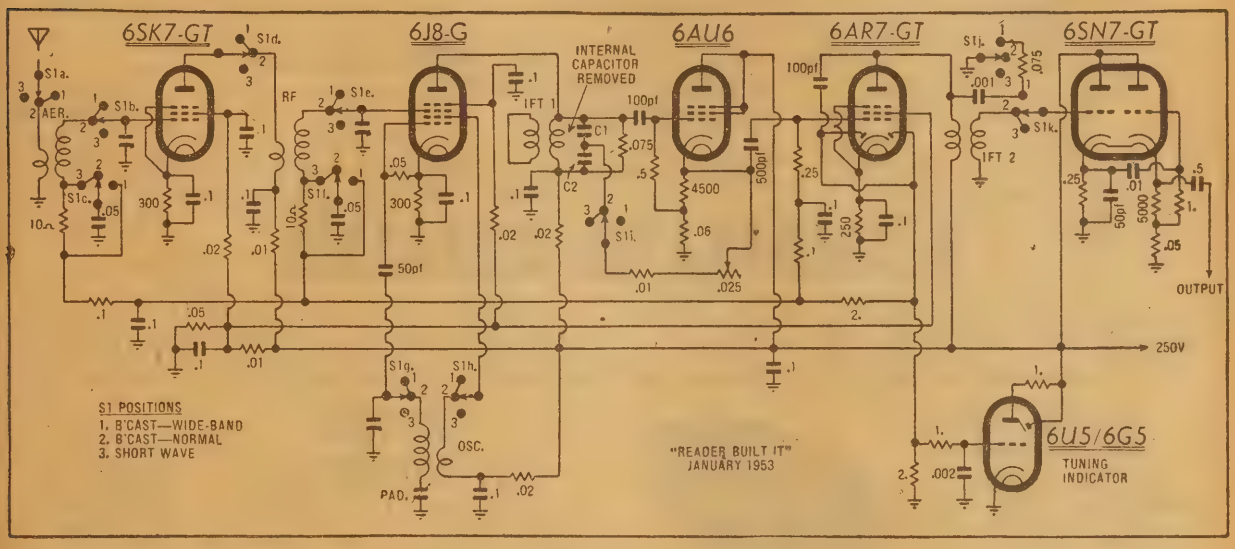
**29b WEST ST., LEWISHAM, SYDNEY.** **LM3555**

We do not accept responsibility for any order damaged in transit.

# A READER BUILT IT!

**Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.**

## AN INTERESTING DUAL-WAVE WIDE-RANGE TUNER




**One aftermath of the publication of the "Playmaster" series of amplifiers in Radio and Hobbies has been the demand for a good wide-band tuner. Here is an interesting design submitted by one reader which is claimed to give good frequency response with standard coils and 455 Kc IF transformers.**

THIS tuner provides wide-band broadcast reception, normal broadcast reception and short-wave reception. The coils could be contained in a standard dual-wave coil unit.

According to our contributor, Mr. E. Robertson, of 20 Iris Avenue, Herne Bay, NSW, the response is 12 db down at 12 Kc when in the "broad" position of the function wavechange switch. For the "normal" and "short wave" positions the response is 12 db down at 4.5 Kc.

### LOWERS "Q"

To broaden the response of the aerial and RF circuits, 10 ohms of straight Eureka resistance wire is inserted in series with the low-potential end of each grid winding. This reduces the winding "Q" from 85 to 25 at 500 Kc.

In the IF channel, a single winding of each IF transformer is used to avoid coupling worries. In each case this winding is loaded with a .075 megohm resistor which reduces the "Q" from 110 to 20.

When the function/wavechange switch is moved from the "broad" to the "normal" or "short-wave" positions, the .075 megohm loading resistor across the second IF transformer is removed and both windings are brought into circuit.

To improve the selectivity of the first transformer for positions other than the "broad" position, a regenerative stage is introduced to multiply its "Q." The arrangement is as follows:

The first IF transformer has one of the windings permanently short-circuited. The capacitor normally connected across the other winding inside the can is removed and replaced by two similar capacitors each twice the value of the original capacitor removed. Because the resulting capacitance value remains as before, the winding will still tune to 455 Kc. The two capacitors are connected in series across the winding to provide an electrical centre-tap.

### FEEDBACK

The triode-connected 6AU6 functions as a cathode-follower and feeds back into the winding to replace the losses in the transformer and the .075 megohm resistor shunting the winding. The .025 megohm potentiometer in series with the .01 megohm resistor sets the total amount of resistance in series with the feedback loop to a point which prevents oscillation. It is adjusted experimentally.

In the last stage, one section of the 6SN7GT operates as an infinite impedance detector, while the other section acts as a cathode follower to give a low impedance output of the order of 500 ohms.

The AVC voltage developed at the diodes of the 6AR7GT is fed to the RF convertor and IF stages. It is also fed to the triode grid of 6U5G electron-ray tuning indicator.

The chassis layout is a matter for the individual. The main point to avoid is undesirable coupling between stages as any unwanted regeneration will reduce the bandwidth. In this connection see that the input is well shielded from the IF channel wiring.

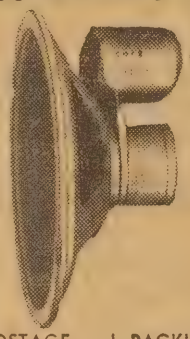
### SWITCHING

The switching functions could be carried out with a 3-pole, 3-position, 4-gang switch. It may be possible to get away with a 4-pole, 3-position, 3-gang switch, if the first section is used solely for the aerial circuit switching.

Our contributor makes the point that when using this set with a Rola 12-QX and the Playmaster No. 2 amplifier, it is necessary to use a sharp cut-off filter on some programs, but on microgroove recordings and live-artist shows it gives excellent results. We would feel that in many locations a 10 Kc whistle filter would be necessary to remove the adjacent channel hetrodyne which usually shows up on wide-band sets, due to the increased frequency response.

# NEW --- SPEAKERS --- AT --- HALF --- PRICE

SPECIAL PURCHASE OF 1000 NEW PERMAGNETIC SPEAKERS MADE BY ONE OF AUSTRALIA'S LEADING MANUFACTURERS ENABLES US TO SELL THESE UNITS AT HALF PRICE



POSTAGE and PACKING

| | NSW | Interstate |
|---|---|---|
| 12" SPEAKERS | 7/6 | 12/6 |
| 8" SPEAKERS | 5/6 | 9/6 |
| 6" SPEAKERS | 5/- | 8/6 |
| TRANSFORMERS | 1/6 | |

## 12" SPEAKERS

HEAVY-DUTY PERMAGNETIC WITH 5000 OR 10,000 C.T. TRANSFORMER .. .. .. .. .. .. .. .. .. **54/-**

WITH 15,000 OR 20,000 TRANSFORMER .. .. .. .. .. .. .. .. 50/-

## 8" SPEAKERS

HEAVY-DUTY PERMAGNETIC WITH 20,000 OHM C.T. TRANSFORMER .. .. .. .. .. .. .. .. .. .. .. **34/-**

## 6" SPEAKERS

HEAVY-DUTY PERMAGNETIC WITH 15,000 OHM TRANSFORMER .. .. .. .. .. .. .. .. .. .. .. **29/-**

Separate Transformers to suit any of above speakers—5000 or 7000 ohm 8/6 each. (Supplied with speakers only.)

# RECORD-PLAYER-CLEARANCE

NEW COLLARO 504 RECORD PLAYERS WITH CRYSTAL OR MAGNETIC PICKUP AND AUTOMATIC STOP .. .. .. **87/6** PLUS FREIGHT

NEW PLESSY RECORD PLAYERS WITH MAGNETIC PICK UP AND AUTOMATIC STOP FITTED WITH PRESS BUTTON SELECTOR . **87/6** PLUS FREIGHT

**Leatherette-covered or veneered and polished cases to suit above 57/6. Plus freight.**

## American Radar Transmitter Type ASB

**CONTAINS**

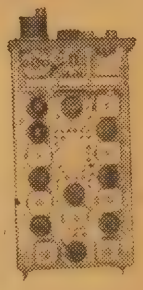
Two U.H F. Triodes Type 15 E
One High Voltage Rectifier, Type 15R.
Four Sets of Lecher Bars.
Transformers, ceramic mountings, Motor Blower, etc. Also High Voltage Vacuum Change-Over Relay. Nominal Frequency 515 m/cs. Ideal for conversion to U.H.F. Channels, Variable Coaxial Cable and Link Matching Lines. Contained in Aluminium Case. Dimensions 18in x 7in x 8in.

**£3/17/6** PLUS FREIGHT

## AMERICAN H.F. RECEIVER ASB

Complete with 11 tubes 7 6AC7, 2 6H6, 2 955 Acorns. Can be altered to 144 or 280 Mc amateur band or FM band.

**£7/17/6** Freight Extra

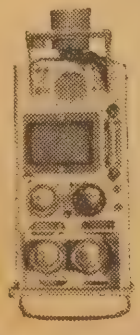


## TRANSFORMER SPECIAL

New 125 mill power transformers. 240V Prim, 385/385 Sec at 125 mill Two 6.3 and 5V fill windings
STANDARD LAMINATIONS Weight 8lb. .. .. .. .. **37/6**

Postage N.S.W. 7/6. Interstate 9/6

## NEW LUCAS ENGLISH GENEMOTORS



Input 12V. Output 250V at 65Ma
Supplied with input filter.

**£2/10/0** Postage N.S.W. 6/6 Interstate 8/9

## FOUR VALVE AMPLIFIER

American amplifier complete with two 7C5, one 7F7 and one 7Y4 valves in brocaded aluminium case. (No power supply.)

Postage N.S.W. 6/- **27/6** Interstate 8/6

## NEW VALVES IN CARTONS

**SPECIALS**

**AV11 — 9/9**

**5BP1 — 9/11**

**V.R.65A — 3/9**

With socket which is suitable for standard octal valves.
Special price for quantity.
This valve is the English equivalent of the EF50 with 4V fil. & English octal base.
Please add postage on valves.

| | |
|---|---|
| 6C4 .. .. .. .. .. | 15/- |
| 6AG5 .. .. .. .. .. | 15/- |
| 6AK5 .. .. .. .. .. | 15/- |
| 955 .. .. .. .. .. | 15/- |
| 1S5 .. .. .. .. .. | 15/- |
| 1T4 .. .. .. .. .. | 15/- |
| 1M5G .. .. .. .. .. | 8/9 |
| 1K7G .. .. .. .. .. | 8/9 |
| 6K7G .. .. .. .. .. | 8/9 |
| Direct replacement for 6U7G. | |
| 1P5 .. .. .. .. .. | 12/6 |
| 5Z3 .. .. .. .. .. | 15/- |
| 1K5 .. .. .. .. .. | 7/6 |
| 8A6 .. .. .. .. .. | 7/6 |
| 6SH7 .. .. .. .. .. | 7/6 |
| 7193 .. .. .. .. .. | 5/- |
| EF50 with socket .. | 11/- |
| 6SH7 OR 1K5 .. .. | 5/- |
| In dozen lots. | |

# METROPOLITAN RADIO SUPPLIES - - - - LM3610

479 PARRAMATTA ROAD, LEICHHARDT (at top of Taverners Hill) N.S.W.

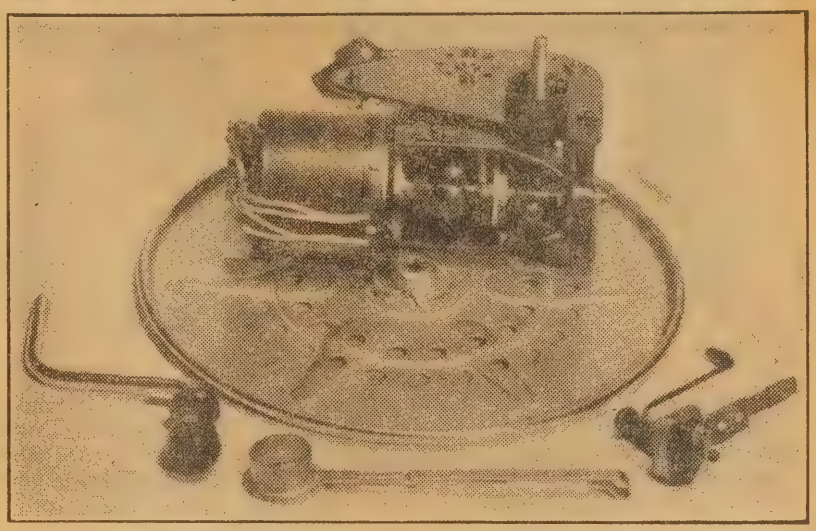
***Trade also supplied*** ***Open Saturday Mornings***

PRICES INCLUDE PACKING, BUT POSTAGE OR FREIGHT MUST BE INCLUDED WITH ALL ORDERS.

# TRADE REVIEWS AND RELEASES

## GRAMO. MOTOR HAS SPRING, WORKS FROM AC OR DC

**Country readers particularly will be interested in a gramophone motor which is currently available from Fred A. Falk and Company. Novel feature of the motor, which is a standard 78 rpm type, is that it can be modified to operate from 32-volt home lighting plants.**



DESCRIBED as the "Dual" model 20C, the motor, as originally supplied, has a large single-section spring for manual operation, plus an electric motor for power operation.

The spring motor is clutch-coupled to the governor mechanism, and may be used as required without any other operation but winding. The spring runs the turntable for five minutes with adequate power.

The electric motor is rated to operate on either AC or DC and either 110 or 240 volts. A simple change to the wiring, however, as described in an instructional sheet, allows the motor to run equally well from 30-50 volts DC, as from home lighting plants.

The speed can be regulated from 60-90 rpm, which would make it useful for driving a tape deck, as well as playing gramophone records. Although not actually tested with such a deck, the motor appeared to run very smoothly and with plenty of power.

All accessories, including mounting bolts, &c., escutcheon, voltage selector, speed lever, spring crank and an automatic stop are supplied with the motor.

Copper mesh brushes are used, to ensure long life, and four suppression condensers are built in to eliminate sparking and electrical interference problems.

The motor is distributed throughout the Commmonwealth by regular trade houses. Inquiries may, however, be addressed direct to Fred A. Falk & Co., of 28 King St., Rockdale, NSW. Full retail price, including postage and freight charges is £15/9/6.

## IMPROVED "HI-FI" CUTTING HEAD

**The manufacturers of "Hi-Fi" recording equipment have recently announced the release of a new model recording head, which replaces their earlier K-E type. The new head is illustrated below.**

MAIN feature of the new type BT/L head, as compared with the earlier type, is the use of torsion bar suspension for the armature. This replaces the knife-edge arrangement previously used, and is claimed by the manufacturers to eliminate the need for troublesome damping provisions.

The assembly is permanent, needing no periodic adjustments and remaining unaffected by temperature and humidity changes.

A balanced armature system is used, push-pull coil assembly, laminated pole pieces, and an improved alnico magnet, ensuring better efficiency and frequency response.

Impedance of the head is 500 ohms at 400 cps and manufacturer's literature quotes the frequency response as being substantially flat from 50-15,000 cps.

The finish is in bright chrome and the head is intended for mounting on conventional recording lathe mechanisms.

Victorian distributors are the Playback Co., Box 5041-Y, GPO, Melbourne. Retail price of the head is £16 including tax. "Stellite" standard or microgroove stylii are available for the head at 12/6 retail, though any standard recording stylii may be used.

## ALL-WAVE NOISE REDUCING AERIAL

**Latest release from the Aegis Manufacturing Company is an aerial filter system designed to minimise man-made interference with radio programmes.**

PRINCIPLE of the system is to allow the aerial proper to be erected high up or as far as possible from the source of interference, whether machinery or electrical wiring. The signal is then conveyed to the receiver through a special line, which does not itself pick up any signals—or interference.

Special feature of the Aegis product is that it is designed to operate on both broadcast and short-wave bands, thereby greatly increasing its usefulness.

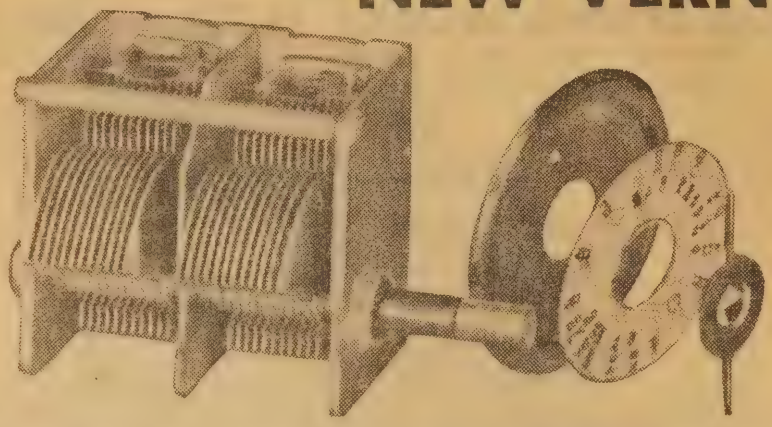
Aegis have elected to market the filter as a complete all-wave, noise-reducing aerial kit. The kit is supplied in a carton and is ready for immediate erection, without the need for further soldered connections.

The kit contains two matched transformer units, incorporating iron-cored coils and a Faraday electric screen. Fifty feet of twin plastic-covered low impedance lead-in wire is supplied, together with 40 feet of earth wire to ground the aerial transformer. There is also 40 feet of 7/22 copper aerial wire and the necessary egg insulations to erect same.

Complete installation instructions are supplied.

The kit, complete as above, retails for £5/14/-, and is available through Aegis distributors in all States. (Aegis Manufacturing Company, 208 Lit. Lonsdale St., Melbourne C.1.)

# THE "ROBLAN" NEW VERNIER DRIVE



**Standard and vernier Roblan gang condensers are now available with maximum capacity values of either 370 or 415 mmfd. (The latter tracks with "H-type" dials). All gangs are supplied complete with mounting feet.**

370 mmfd gang has 12 rotor plates and the 415, 13 rotor plates. The new vernier drive is supplied as a complete tuning set including metal escutcheon, calibrated celluloid dial and pointer.

All units are inspected and passed by our test laboratory and are therefore guaranteed against faulty workmanship and material. Obtainable from leading wholesalers throughout Australia.

MANUFACTURED BY

## Robertson and Lansley Pty. Ltd.

3 MOORE STREET, LEICHHARDT, SYDNEY, NEW SOUTH WALES. PHONE MW3632.

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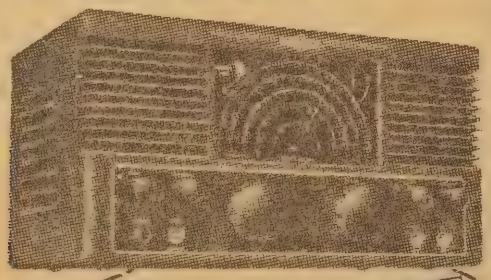
# AT LAST! *A communications receiver designed with* YOU *in mind!*



*The* EDDYSTONE "740"

£93/10/- F.O.B. MELBOURNE SUBJECT TO CHANGE WITHOUT NOTICE

- **TIP-TOP BRITISH CONSTRUCTION YET SURPRISINGLY LOW IN PRICE!**
- **SPECIALLY SUITED TO "HAM" COMMUNICATIONS WORK!**

You may find it hard to imagine that a communications receiver of first class British construction could be the lowest priced top-performance receiver on the market! But it's a fact! What's more the Eddystone "740" is specially designed to meet the exacting requirements of "hams" with a host of important features:

- Wave range from 30.6 MC/S to 620 metres in 4 bands, with astounding selectivity.
- Excellent signal-to-noise ratio.
- Features BFO for morse reception, switch-controlled noise limiter, and an efficient AGC system.
- Loudspeaker independent of housing.
- Adaptable to either 6 volt battery or electric operation.
- For a free, illustrated technical leaflet, write to your nearest Eddystone distributor, or to:

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**R.H.CUNNINGHAM PTY. LTD.**

118 WATTLETREE ROAD, ARMADALE, S.E.3. CABLE "CUNNIC" MELBOURNE TELEPHONE UY6174

# HOW TO LAY DOWN CONCRETE PATHS

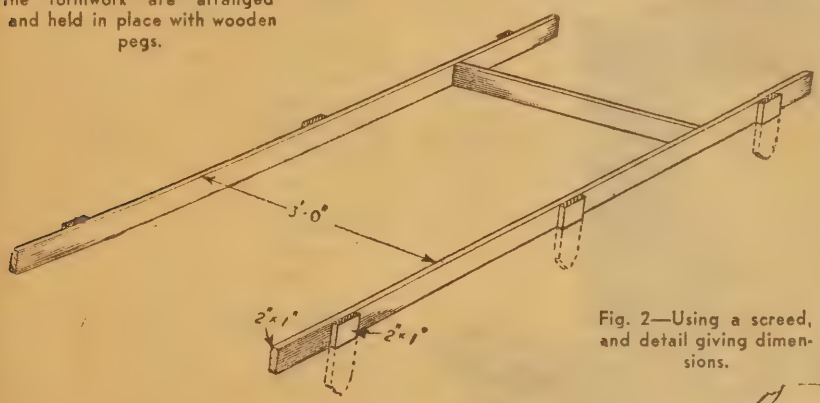
**Many Australian home-makers are doing their own concrete work on new paths, driveways, and so on. A few pointers from the voice of experience are always helpful. This is the first of two articles which will tell you how to go about it.**

The laying of a concrete path is not a complicated business, but there are certain conditions to be observed if the path is to be durable. One sees so many paths which in a comparatively short time have cracked and crumbled that it is obvious that these essential conditions are not always complied with.

## SITING THE PATH

First decide on the site of the path in relation to the garden plot. The path will be a permanent feature, and if wrongly placed in the first instance it may be a permanent nuisance.

Fg. 1—How the boards for the formwork are arranged and held in place with wooden pegs.




Sited directly down the centre of the plot it may leave insufficient room on either side for a well proportioned lawn, as well as giving an impression of undue regularity and formality. On the other hand, in most cases the path is used by the housewife when hanging washing on the line, and if it is sited too far to the side the clothes may blow on to the fence.

Paths should preferably lead directly to some feature which forms a strong focal point. It may be a summer house, a pool, or a bird bath and feeding table, but in any case the path should not merely trail out indeterminately.

The lay of the land, too, should be studied. On a gently falling site the path may be laid to follow the slope of the ground, but if the fall is steep it will probably be better to run level sections of the path, say, 15 or 20ft long, breaking each section with a step.

This in itself will lend interest to the path as a garden feature and will be well worth the effort of excavating the soil where necessary.

## PREPARATION OF THE GROUND

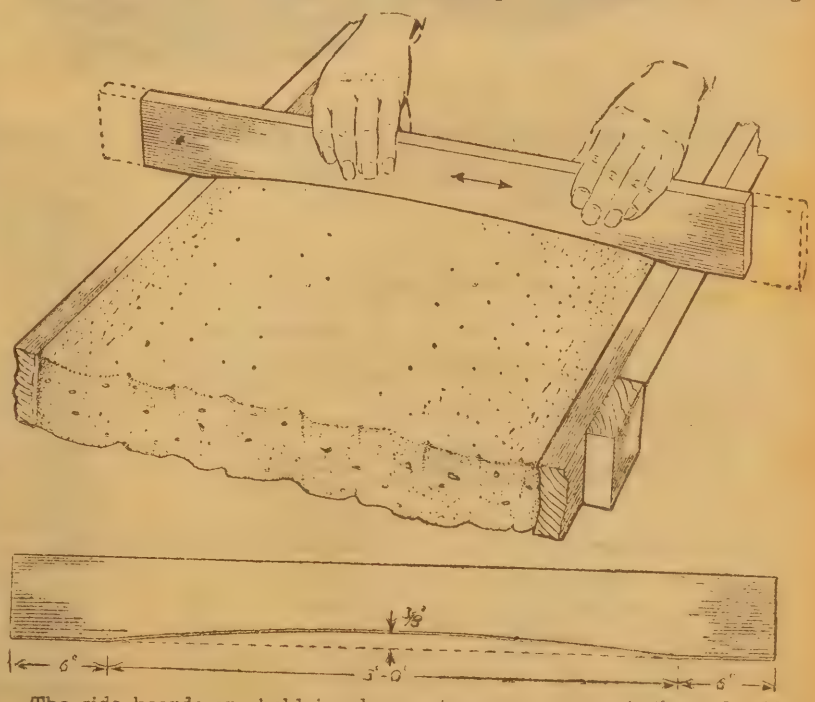
Having sited the path, define the site with pegs and string or a garden line, and remove the turf and any loose surface soil. On loose, soft ground ram in stone, broken brick, clinker, and so on, to form a solid base.

On firm, heavy ground this is generally not necessary, and a sufficiently firm foundation may be formed by rolling, or even beating with the flat of a spade.

## FORMWORK

The formwork for a straightforward concrete path is very simple. Boards are laid along each side of the site of a width equal to the thickness of the path. In the case of paths of up to 3ft wide on a solid foundation, 2in of thickness is ample. Wider paths and those on loose, soft ground, should be 3in thick to avoid subsequent cracking and drives which have to withstand the weight of cars should be at least 4in thick.

Fig. 2—Using a screed, and detail giving dimensions.




The side boards are held in place by stout pegs driven firmly into the ground on the outside of the boards (see Fig. 1). Cross-pieces are then fixed at about 5ft intervals. These can be of ½in thickness, in which case they are left in after the path is laid, or they may be stouter boards which are removed as laying proceeds.

If the cross-pieces are to remain, the laying of the concrete is done continuously from bay to bay, but if they are to be removed alternate bays are laid; the cross-pieces are removed when the concrete has set and the intermediate bays then filled. Cross joints, made by either method, are necessary to prevent risk of subsequent contraction cracks, or warping of the slab due to expansion. To economise in timber, 20ft of the formwork may be fixed at a time and moved on when the first section is laid and set.

## THE CORRECT CONCRETE MIX

For work of this nature there are two alternate mixes. The first, known as the "one-two-three" mix, consists of one part cement, two parts sand and three parts shingle. The other is of one part cement to four parts of mixed ballast. Shingle is usually easily obtained at builders' yards.

Mixed ballast should be graded from about 1½in down; that means that the largest stones are not more than 1½in in diameter. If a few larger stones are present they should be removed when mixing for paths of 3in thickness or less.

As a rough guide to the quantities required it may be calculated that, for

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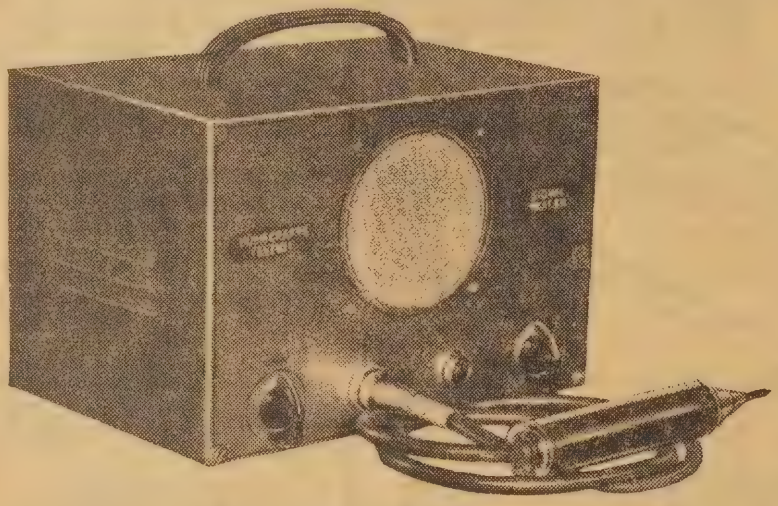

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a path 90ft long and 3ft wide and 2in thick, you will require 9 cwt cement, 1 cu. yd. of sand and 1½ cu. yd. of shingle, using the one-two-three mix. If using mixed ballast you would of course need 2½yd of ballast and 9 cwt. of cement. These quantities are calculated to the nearest cwt. of cement and the nearest ½ cu. yd. of aggregate, and are on the generous side.

## MIXING THE CONCRETE

The concrete must be mixed on a clean surface, and a swept area of paving or concrete is ideal. Measure the quantities accurately, and an ordinary bucket is convenient for this. For one bucket of cement, two of sand and three of shingle you will need a little over half a bucket of water to produce a usable mix.

Spread the measured quantity of aggregate in a flat heap. Aggregate, by the way, means the coarse part of the mix—the sand and shingle or the ballast. Now spread the cement evenly over the heap. The whole is then thoroughly mixed by being turned over with a shovel until the mass is of a uniform color, with no streaks of brown or grey. At least three completed turnings will be necessary.

Measure the correct quantity of water into a watering-can with a rose nozzle and sprinkle it slowly over the heap, pausing frequently to turn it over with a shovel. Continue until you have a thoroughly mixed plastic mass of uniform color and consistency. You can test for a good mix by taking a handful of the concrete and squeezing it. It should retain its shape under slight hand pressure and the surface at the same time should become moist without dripping.

## PLACING THE CONCRETE

It is of the utmost importance that concrete should be placed as soon as possible after mixing; certainly no longer than half an hour should elapse. If the ground is dry the surface should be sprinkled with water just before the concrete is placed. If the surface is waterlogged, place sheets of old newspaper over the site before laying the concrete.

Fill one bay at a time, working the concrete well into the side boards and then distributing it with an ordinary garden rake. At this stage let it be up to ¼in above the height of the formwork. Level it off with a wooden screed, used first with a chopping motion and then with a backward and forward sawing action. Notice that the screed shown in Fig. 2, which is made out of 4in x 1in timber, has its lower edge shaped to a slight curve. This curve should be about 3-8in depth for a path 3ft wide. It gives a camber to the surface of the path which throws off the rain.

By the above method of screed finishing a rippled, slightly roughseded surface is obtained, which is non-slip. If, however, a smooth surface is desired, it is obtained by subsequent smoothing with a wooden float. This need not be an elaborate affair, and Fig. 3 shows one which may be made in a few minutes out of waste wood. This trowelling must not be overdone or fine hair cracks will develop later. Further, a glassy surface will be produced which will be positively dangerous in frost.

Another form of surface finish given to a path made with shingle and which has the appearance of a gravel path is obtained if, about one hour after the concrete has been laid, it is brushed with a hair broom to remove surface mortar. Some time later, when it is found by experiment that the shingle is not easily dislodged, it is again brushed with a stiff broom, leaving the stones of the shingle slightly proud of the surface.

It is very important to protect newly-laid concrete from the effect of fierce sunlight and drying winds, and if these conditions obtain during the first week or so after laying, the surface should be protected with wet sacks, strips of old carpet, &c.

## COLORED PATHS

The best-laid path of ordinary concrete is apt to be rather dull, and it is well worth while considering the effects which can be obtained by the addition of coloring powders to the cement.

For this purpose ordinary dry colors may be used, but those made specially for the purpose are well worth the little extra cost. They have a much greater staining power and permanence of color, and are resistant to frost, heat and light. They are used in the proportion of 10lb of powder to each cwt of cement and they are thoroughly mixed with the cement before it is added to the aggregate.

These powders are made in about a dozen colors, and are intermixable so that almost any shade may be obtained. If more than one color is used, however, great care should be taken in measuring so as to avoid differences in shades in a long path. This consideration is not so important if the path is laid in paving slabs.

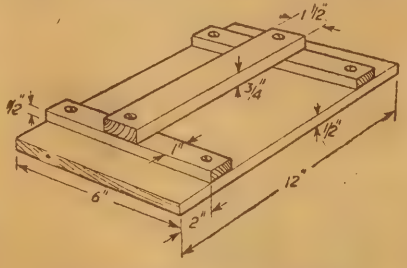

Fig. 3—Details of a wooden float.

In the next article it is proposed to deal with the whole subject of the making and use of in situ and pre-cast slabs for paths, dry walling, steps, pergolas and other features in the garden.

## NEW INSTRUMENT FOR BLUE BABIES

A NEW cutter for operating on "blue babies" is reported in the Journal of the American Medical Association. The instrument is used to cut the constricted valve in the opening between the pulmonary artery and the right ventricle of the heart. Babies born with this condition may be "blue babies."

The new instrument, made by Bruno Ritcher, of Glen Ellyn, Illinois, was devised to decrease the size of the wound in the heart made by previous instruments which had diamond-shaped cutting blades. Less bleeding and disturbance of heart rhythm are other advantages of the new instrument.

## FITTING GENERATOR BRUSHES

**To keep a generator in good running order, it is advisable to check the brushes occasionally. They should be replaced when worn to about half their original length.**

SIMPLY remove the two through bolts which run the length of the generator housing and pull out the armature assembly. Clean the commutator with 0/0 sandpaper and scrape any dirt from between the copper segments. This can be done with a piece of hacksaw blade, the sides of which have been ground slightly to reduce the width of the teeth. Use the blade to saw gently between the segments until a white dust is produced.

Before installing the new brushes, tape a piece of sandpaper around the commutator, insert the commutator shaft in the end frame and place the brushes in their holders. Move the commutator back and forth in an arc of about an inch or so until the face of the brushes are cut to the radius of the sandpaper.

Doing this will ensure that the entire surface of each brush comes into full contact with the commutator and thus prevent overheating.

Check that the brush lead is replaced in the holder in its original position, making sure that the terminal under the screw does not bind the brush. Also be sure that the terminal does not stand out from the brush holder such that it can short-circuit to the generator frame.

After it is replaced in the car, the generator may be repolarised by passing current through it from the battery. This can be done by momentarily "flashing" a jumper wire from any "hot" lead, such as the starter terminal of the B post of the regulator, to the A terminal of the generator. It can also be done by momentarily holding the cut-out down.

The generator is properly positioned when the fan belt is aligned with the generator pulley and belt tension allows about half an inch of up-and-down movement in the belt halfway between the fan and generator pulleys.


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# OFF THE RECORD — NEWS & REVIEWS

**The import restrictions have had the inevitable effect of causing a shortage of high powered, wide range speakers. Even replacement cones for these are scarcer than hen's teeth, as I found to my sorrow after having mine accidentally blown up. As a result we have had some recent queries asking about fitting tweeters to standard speakers.**

*By JOHN MOYLE*

THE general idea seems to be that the "highs" could be improved by adding a standard small speaker as a tweeter—maybe one of the 6-inch types—on the theory that it would be a better high note producer than a 12-inch main speaker.

## SMALL TWEETERS

It is true that, in the main, a tweeter is smaller physically than a "woofer." It does not require a large diaphram to reproduce the upper registers, and it does require a light, stiff cone. But considering a small standard speaker as a candidate for a tweeter, there the resemblance ends.

Just because a speaker has a 6-inch cone, that doesn't make it a tweeter. Such a speaker generally has a much higher cone resonance than a big speaker—possibly about 120 cycles or even higher. After that it may easily rise fairly steadily to a sharp peak, maybe between 3500 and 4500 cycles, and after that it may do anything. It may have a further peak a bit higher up, but the makers would never claim that it would be much good in the region we want a tweeter—something over 8 or 9 kc.

Small speakers are primarily for use in sets where space is at a premium. They are not intended as wide range speakers, or even very good speakers, except for special types. The fact that the makers must chase efficiency—watts out for watts in—makes their job even harder, and taking it all round they have done well.

But even assuming we feed such a speaker so that it is mute below about 6 kc, and rely on what it will give above that figure, the efficiency is likely to be so low that its output will be masked by that from the main speaker, unless it is a very bad one.

The only solution here would be to feed more power into the tweeter. But this isn't as easy as it sounds, and might well call for special circuits and components beyond the scope of the average semi-technical listener.

## MODERN SPEAKERS GOOD

Another thing we must consider is that a good modern 12-inch speaker (and that includes the 12-0, to give our local factories a boost) we found to be rather better at the top end than the average small job, and more efficient into the bargain.

Adding extra speakers under these circumstances is likely to result in re-inforcement of the upper range, but with little or no improvement at all in the real top end up to say 12 kc. Some time ago we made some experiments on these lines and finally gave it away as rather profitless.

At the same time, I wouldn't say that, if we went to work on a small speaker to stiffen the cone and so on, so that it would radiate more efficiently where we wanted it, and then fed it with a separate HF channel so that we could balance its output against that of the larger speaker, there mightn't be some future in it.

## SPECIAL WORK

But this technique would call for some special work, and is more in the line of the keen builder than that of the semi-technical listener for whom these notes are primarily written.

There are plenty of problems in this tweeter business. I may have misled one or two by references to a tweeter I have been using for some years with a big, single cone main speaker. But this tweeter was specially made for the purpose, and bears little resemblance to the ordinary small job. It really does "give out" as high as one can hear, and does it reasonably smoothly. A peaky tweeter can easily prove one of the most diabolical torture instruments ever devised, apart from the distortion it is bound to produce, and to highlight on records which aren't so clear. Even the best wide-range speaker calls for great care in use, as any owner will tell you.

So that we aren't enthusiastic about spending time and money on the idea.

These remarks in no way apply to using more than one standard speaker to improve the power handling ability of a system. This is a valuable approach in many cases. If we are forced to use speakers which don't handle too much power at the low end and only the real big jobs are good down there, we can double this capacity by using two speakers. Three of them properly fed in parallel, and appropriately mounted, can sound really fine

## BATTERY OF SPEAKERS

I once heard a battery of stock speakers—I think there were 24 of them—mounted on a big baffle and fed from a large amplifier. None of the speakers alone could handle much bass without overloading, but 24 increased their capacity by a like multiplier. It was astonishing to hear how well the thing sounded, particularly as each speaker was being run well within its power rating at all frequencies.

Naturally the speakers were correctly phased so that their cones moved in unison, and a specially-made output transformer looked after the matching.

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Speaking of special speaker systems, the following passage took my eye in the English Gramophone, written by G. Howard-Sorrell. This stereoscopic effect isn't new, and was demonstrated by Ray Alsopp in Sydney during an IRE convention before the war. I had some success with a scheme which acoustically divided the sound from several speakers so that the lows and the highs radiated from two points separated by about 10ft. The effect of wider sound source was quite remarkable, and the division of instruments by their pitch gave an impressive "presence." I'm still of the opinion that some day this principle will be heard of again.

Says G. Howard-Sorrell:

I suppose there is no doubt that the major difficulty in the realistic reproduction of sound is the limitation to monaural listening forced on us by the single channel systems used at present.

## TWIN TRACK RECORDING

Those of you who visited the radio exhibition at Earls Court may have heard the demonstration two channel system of GEC. Using twin track tape recordings which were reproduced through two amplifiers and loudspeakers, this demonstration was impressive in its scope and although of course the recordings made had been chosen with an eye or rather ear to the spectacular it was clear that here is an opportunity to make the next step in sound reproduction.

Prior to the opening of the Earls Court show, we had a chance to hear, at the Wembley Laboratories of GEC, not only the two channel set-up but a more elaborate three channel arrangement using three microphones as inputs.

A dance band playing in a studio was reproduced in a small hall with such effect that one was able to mark out on the imaginary stage the location of the various instruments in the band, it was noticed that though the three speakers used were all at the same height above floor level there was a definite impression that the band had vertical as well as horizontal perspective which perhaps only goes to show how easily the ear can be deceived. The final demonstration with the triple channel was of a pipe-major marching around the studio, again the audience was persuaded that the piper was marching around the space behind the curtain which screened the speakers.

Reverting to the more practical side, the dual channel system has distinct possibilities for home reproduction even though it may be some years before such equipment becomes available for public use.

## DEMONSTRATIONS

The twin track tape used for recording the program demonstrated to the public was not by present standards high-fidelity the track speed being only 7½in per second, which puts a definite limit on the upper register, but despite this the dual channel system gave an expression of realism which greatly exceeded that possible from a single channel equipment of similar range.

Perhaps the most striking demonstration here was of a tambourine recording in which the instrument was thrown from side to side of the studio, the reproduced sound appeared to travel from side to side between the two speakers in use, the audience followed the sound, rather as spectators at Wimbledon follow the ball.

It should perhaps be made clear that the real purpose of the whole demonstration was to prove the effectiveness of Osram valves and to show that amplifiers using these valves can, with suitable sound sources and loudspeakers, provide reproduction of the highest possible quality. The loudspeakers used were unconventional, having cone diaphrams made of aluminium alloy. These have been under development in the GEC Laboratories for several years, in fact they were first made well before the war, and although there are many problems to be solved before such units are available for general sale, it is intended to go ahead with production at a later date.

There is no doubt that these metal diaphram speaker units have considerable possibilities, and contributed much to the effectiveness of the demonstration. The stiff cones gave a cleanness of reproduction which was quite remarkable and appeared to be free from the tinny resonances which distinguished some early types of metal cone speakers which were produced in past years.

## RECORDS IN 1953

As we go to press I learn that there is a good chance of import restrictions being lifted early this year from sterling countries. This I presume will mean that once again we will be able to import records into this country from England. At the moment, there are comparatively few LP records left in stock so that sales of necessity have been extremely limited.

But as I have previously remarked, 1953 should see these records really make an impression on the market —in fact, we can probably say that this will be the first year during which LP's will have had an opportunity to register their full impact.

One reason will be that the EMI group recordings which are already selling in England will be seen here. I feel now that EMI will probably not do very much until they are able to bring in English pressed discs. It is probable that Australian manufacture will be concentrated on the 45 speed records which will include popular numbers as well as semi-classical items. The company's policy has been to concentrate imports to the classical material, and this might logically be expected to apply to LP's as well.

## NIXA RECORDS

Nixa records will also be on sale in larger quantities this year. I have received information from the company about their immediate plans, most of the records mentioned being classical types.

I sincerely hope the impact of all this microgroove activity will have an appropriate effect on the quality of radiograms available to play them. Manufacturers are up against the economic factor all the time, but some of the rather make-shift efforts to date have been rather shocking, and they will do harm to the cause. The position particularly in motors and pickups is far from good.


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# SHORT-WAVE NOTES BY ART CUSHEN

## ORU, BRUSSELS CONFIRMS RECEPTION

A verification letter from Mr. L. Le Roye, head of Public Relations, Station ORU, PO Box 26, Brussels, is to hand, in which he pays a tribute to the fine co-operation received from Australian and New Zealand listeners to the new station.

READERS will be interested to know that all verifications will be sent out shortly, but, due to the change-over from Leopoldville to Brussels, replies will be somewhat belated.

Mr. Le Roye would appreciate hearing from listeners about the reception of the ORU DX session, which is broadcast on Thursdays at 6.15 am, and which is at present being received at fair strength on 11,850 Kc. They would welcome any DX tips for the session, and state: "by doing so, we aim to promote the better knowledge of the work and the activities of the various DX clubs existing in various countries."

★ ★ ★

**VENEZUELA.** — YVLK, Radio Rumbos, Caracas, has installed a new 10 Kw transmitter and commenced a session in English at 9 am. Though reception of this session isn't possible here, the station can be heard opening at 8.30 pm on 4970 Kc.

A recording of part of the English program was featured in the DX session from Stockholm (Sweden) in which the announcer was heard asking for reports from any listener on the strength of the new transmitter.

**BRAZIL.** — Several new stations have been heard from this country in the last few weeks, the latest being ZYR63, "Radio Emisora de Piratininga," Praca do Patriarca 26, Sao Paulo, signs on at 7 pm on 6025 Kc, using the power of 50 Kw. Complete schedule from the Swedish session is given as 7 pm-2 pm (next day).

This station has been heard opening at 7 pm, at fair strength, though side interference from DZH6 (6030) is troublesome. A further Sao Paulo station, PRB4, has been conducting experimental broadcasts on 11,855 Kc at 6 am, using the call sign of the medium wave outlet PRB4. Jack Corbett, Brisbane, reports hearing the new XYR57 "Radio Cultural," Sao Paulo, 9745 Kc, opening at 7 pm with morning exercises after the playing of The Bells of St. Mary's. Signals are fair, but interference is sometimes severe from a nearby Moscow outlet.

## FROM THE MAILBAG

YNBH, "Radio Panamericana," Managua, Nicaragua, verified with a letter signed by the owner, Luis Felipe Hidalgo. The station operates on 6055 Kc, but has been assigned 6015 Kc, to which frequency it will move when the Atlantic City convention, making all stations operate inside the normal short-wave bands, comes into effect.

Radio Omdurman, in Khartoum, PO Box 522, is the full address, verifies with a letter and sends a copy of the Sudan Almanac, a very informative book on all the features of the country. Omdurman at present operates on 9746 and 7000 Kc, 2.15-2.45 pm, 2.30-5.30 am in Arabic daily, 6.0-7.30 pm (Friday), midnight-1 am (Saturday) and 6.0-7.0 pm (Sunday), all in Arabic. English is presented on Saturday 3.30-4 am.

HC4EB, Radio Manta, Apartado 4869, Manta, Ecuador, verifies with a letter by airmail and postcard view of the city.

## DIGEST OF DX TIPS

| kcs | Call and Location | Time Heard |
|---|---|---|
| 3420 | VUD, Delhi, India | Request program, 11.45 pm. |
| 3850 | EQO, Teheran, Iran | Strong at 12.30 am. |
| 4900 | Colombo, Ceylon | Chinese program, 12.15 am. |
| 7180 | JO?2, Tokio, Japan | English news, 10.00 pm. |
| 7180 | JOA2, Tokio, Japan | English news, 9.00 pm. |
| 7405 | R. Herondello, Hanoi | French program, 10.30 pm. |
| 11850 | ORU, Brussels Belgium | DX session, 6.15 am, Thurs. |
| 11930 | VUD Delhi, India | Hindu program, 3.15 pm. |
| 17805 | DZ16, Manila, Philippines | Good 1.30 pm. News 8.00 pm |
| 17830 | TAV, Ankara, Turkey | English news, 11.30 pm. |
| 17865 | Damascus, Syria | Sign no 12.45 am in English. |
| 17870 | GRP, London, England | GOS, 1.15-2.15 am. (GRP moved from 18130.) |
| 21510 | ORU, Brussels, Belgium | Fair signal from 8.00 pm. |

## New schedule being used by Brussels is as follows:

Stations—ORU, Wevre, Belgium, 100kw.
OTC, Leopoldville, Belgium Congo, 50kw.

| AEST | Program | Frequencies | Direction |
|---|---|---|---|
| 8.00-10.00 pm | For Belgian Congo (French-Dutch) | ORU 17860kcs 21510 | Africa |
| 10.00-11.00 pm | Missionaries | ORU 21510 15335 | Africa Far East |
| 3.00-4.00 am | Missionaries-Seamen | ORU 9745 11850 | Africa South America |
| 4.00-7.30 am | Belgium Calling the World. English. 6.15 am. | ORU 9745 ORU 11850 | Africa Africa |
| 7.30-9.30 am | Seamen | ORU 9745 11850 | Africa North America |
| 9.30-11.00 am | Portuguese-Spanish | ORU 9745 9767 | Africa South America |
| 11.00-11.45 am | French-Dutch | ORU 9745 ORU 9767 OTC 9655 | Africa America South America |
| 11.45 am-noon | Music | ORU 9745 OTC 9655 | Africa North America |
| noon-3.00 pm | French-English for USA and Canada | ORU 9745 ORU 6065 OTC 9655 | Africa North America North America |

## BROADCASTS IN FRENCH

PARIS has sessions in English and French called "The French Have a Word for It," which would be of value to listeners interested in this language. This is broadcast from Paris daily (except Sundays) at 5.45 pm on 6145 and 7240 Kc and at 5.45 am (except Monday) on 11,970 Kc. Programs in French best received include the transmission to Tahiti on 9550 Kc, 3.30-4.30 pm, to New Caledonia on 17,850, 15,240 Kc, 5.30-6 pm, and to Indo-China, 8.30-9 am on 9675, 11,920 Kc. London has French broadcasts 4.30-4.45 pm in the 49, 41 and 31 metre bands, 6.15-7 am in the 49 and 41 metre bands. This latter broadcast includes news commentary and program. Nearer home, Radio Noumea, on 6000 Kc, operating 5.0-8.40 pm, provides a good signal, with the program in French.

NEWS of DX items heard by readers would be appreciated. Send your comments to Arthur Cushen, 212 Earn St., Invercargill, New Zealand. Closing date for next issue is January 10.

**VIETNAM.**—Two new stations in this country are being heard well in Japan, according to advice from the Japanese Short Wave Club in Sendai. We hear one of these, Radio Hirondelle, Hanoi very well at 10.30 pm when a modern musical program is presented, announcements are in French and the station uses a one-note chime as an interval signal. Hirondelle operates on 7405 Kc, 2.0-4.30 pm, 8.30 pm-1.0 am. Radio Laos, Laos, Vietnam, on 7215 Kc, is reported with news in French 11.0-11.15 pm.

# THE HAM BANDS WITH BILL MOORE

**Field days have always been a very popular feature of amateur radio activity. These functions provide amateurs, who have only met over the air via morse key or microphone, an opportunity to discuss their ideas in person.**

FOR the third consecutive year more than 200 persons assembled for the NSW Divisions' WIA annual field day held at Woy Woy on Sunday, November 16. Despite the gloomy weather prophets, and the previous night's heavy storm, the weather held fine for the event. Since the inauguration of Woy Woy field days, we have never experienced bad weather for the day.

The Hunter, Wollongong and Sydney groups attended at good strength, and from farther afield came Rod Pike (VK2ACU) and Norm Moody, of Coonamble, Arthur Yates (VK2ZP), of Inverell, and Len Turner (VK2LR), of Kyogle.

DX was represented by Bob Black, YJ1AB (VK2QZ), and Bill Storer, VK1BS (VK2EG), the latter without his beard displayed in QST.

## EVENTS PROGRAM

The day was officially opened just before 11 am by State president John Moyle (VK2JU) and immediately the competitions were commenced. Wal Nye (VK2XU) presented the Gentlemen's Quiz, and the winners displayed a good all-round knowledge of amateur affairs. In first place was Johnnie Walker (VK2GA) and second Ted Whiting (VK2ACD).

The next event was the Ladies' Quiz, conducted by Jim Corbin (VK2YC). The XYL's had to supply the answers for a number of questions concerning their everyday operations, and Mrs. VK2AML was the winner, receiving a suitable trophy.

The quest for the frequency of the tuned circuit created much interest and guesses varied many Mcs from the correct figure, 7168 Kc. Winner of the competition was Henry, of VK2AMW, with 7140 Kc, and in second place was Allan Cole, VK2ACC, 7120 Kc.

Holder of the OM's lucky number was Alex Dan (VK2ABU), second Allan Smith (VK2AIR, now VK9YY).

During the morning session the half-hour all-band scramble was conducted—any band, any power, the station contacting the greatest number of stations in the prescribed period winning the trophy.

Conditions were extremely poor on the HF bands and the winner of the cup was Barry White (VK2AAB), who used 144 Mc exclusively. VK2ARF was second after a countback, while VK2ZC was in third place.

After lunch another scramble was evident, while various crews assembled their equipment for the transmitter search. The event on this occasion was confined to 144 Mc. Previously a transmitter running on 3.5 Mc simultaneously allowed parties with equipment for this band to participate.

In view of the short period (about 15 minutes) required to locate the hidden transmitter on similar field days, it was decided to make the search more difficult. The location of the gear was left to Major (VK2RU) and his wife, who guided the transmitting party, comprising VK2ANF, VK2QZ, VK2EW and Es Griffiths, to the selected spot.

## TRANSMITTER HUNT

15 parties headed out on the search and, as anticipated, there were plenty of headaches for the competitors. The first team to locate the transmitter was headed by Maurice Butler (VK2AAN), and, using a four-element beam, took 45 minutes for the search. The only other party successful in the search was Jack Hill (VK2ADT), whose group, using three elements, arrived just half a minute before the transmitter closed down after the arranged one hour's operation.

The departure of the searching parties was the signal for the commencement of the special program for the ladies, while the children were taken to the local park for their usual races. The latter were in the charge of Mrs. 2ZC 2XU and 2HZ, and everyone won a prize.

The ladies competitions were keenly contested and results were as follow: "Roll the Penny," Mrs. VK2SF; "Pick the Melody," Miss VK2KG; "Drive the Nail," Mrs. 2DG. (All prizes went to Newcastle!)

The last competition created much interest. It was very evident from the proficiency of XYL's driving nails that they do most of the nailing around the homes! Mrs. VK2VU and Mrs. VK2ACD received prizes for lucky numbers, while Ken VK2KG managed to add an 832 to the tube collection from a raffle.

The official portion of the day commenced at 4 pm when the president of the Hunter branch Lionel Swain (VK2CS) presented the prizes to the winners. These prizes were donated by the NSW Division, except two specials for the youngest baby and the youngest XYL, presented by Ern Ashley (VK2ASE)

The usual bran dip was conducted and one prize an old pick-up 1923 vintage was much admired.

John Moyle (VK2JU), State president, concluded the event after thanking all attending for their support.

Of the many highlights we should record the work of local members Cec Hardman (VK2KR) and Johnnie Walker (VK2GA).

Major (VK2RU) conducted the swop-table, while Jack (VK2OF( officiated in the kitchen.

Much of the general organisation was the responsibility of Wal Nye (VK2XU), who also acted as MC, while Jim Corbin (VK2YC), QSL Bureau, Bill Moore (VK2HZ), registration, Dick Dowe (VK2RP), and Maurice Butler (VK2AAN), dispensing, and many others assisted in various ways.

The whole day was run at high pressure without a dull moment, and the council appreciated the support afforded the day from members all over the State.

# ARRL OPPOSES CALLING PROCEDURE

The suggestions of the FCC for the introduction of calling and answering frequency sectors for American stations were listed in these columns in the October issue. Considerable criticism is being directed by American amateurs in general, and the ARRL in particular against the scheme. They point out the weaknesses of such an arrangement.

Briefly, the idea was to set aside certain segments of each band for calling CQ and answering these calls, the QSO when established to be continued in another sector of the band.

Some of the more critical comments by the ARRL on the proposals are as follow (this comment was forwarded to the FCC in an official communication on current regulatory dockets):

In an example case a station in one of the named segments would initiate a CQ call of not more than the specified length. A second station would answer and, after making suitable arrangements, they would open up on other frequencies or frequency as deemed suitable.

A careful examination of the practical application of this procedure in the light of established amateur operating practices shows the proposal to be unrealistic, inefficient and wasteful of precious frequencies.

The stations operating would have many difficulties from the start. Firstly, they must decide on a frequency; even this point, depending on whether stations use VFO or crystal control, could be a problem. When they do change they may be competing with some S9 interference. Even when the frequency has been changed the same calling and answering procedure as used in the restricted segment must be repeated to re-establish contact. Thre is no saving in operating time by the use of special segment calling.

There is, too, the practical problems of a frequency shift of any magnitude. Changing to a working frequency within the remainder of the band would in most cases mean retuning the transmitter.

Most important is the fact that it must be done under key down conditions, thus further increasing the interference problem.

The ARRL recommend that the whole proposal be withdrawn.

Amateur operating through the years has been streamlined, as the bands have been narrowed, and a short listen to any of the better known operators will clearly illustrate how all superfluous signalling has been discarded.

# AMATEUR LICENCE FIGURES FALLING

It was generally anticipated that the amateur radio population would increase rapidly after the war, as so many service personnel trained in electronics would seek an outlet for their enthusiasm in amateur radio. Such was the case, although the increase was not as great as some amateurs anticipated.

It would appear, however, that the peak in licencing was reached some time ago, and in several countries a drop in the amateur strength has been noted.

Licensing figures used for computing the scores in the RD contests for 1951 and 1952, show a falling off in total population. NSW and Queensland totals showed losses—1091 to 1028, and 307 to 303. All other States showed increases—Victoria 947 to 955, South Australia 327 to 330, Western Australia 181 to 186, Tasmania 93 to 107. If it had not been for the large drop in NSW totals would have been about equal.

In Great Britain no figures are available on total licensed, but the drop in the number of candidates for the Radio Amateurs' Examination reflects a similar trend. In 1950 823 candidates sat for the examination and 653 were successful. In 1951 604 candidates sat, with 505 successful, while this year 534 candidates sat and 423 passed.

The figures show a drop in the number of new licences by one-third since 1950, a considerable fall.

Recent ionospheric propagation conditions have caused some generally dropping off in amateur activity, especially among old-timers, but this should have little effect on influx of new faces to the ranks. We do not seem to be attracting to the hobby the youths that prewar comprised the greatest percentage of the population. This is reflected when one reviews the average age of members attending WIA meetings—perhaps the figure is about 35 years of age.

Why we are not attracting youths to the hobby is a matter for conjecture and varied reasons could be brought forward on the subject.

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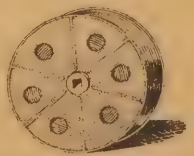

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# THE R & H TAPE ADAPTOR No. 1

(Continued from Page 55)

capacity cable, as recommended for the output circuit of the pre-amplifier, is not nearly so important, and it is much more convenient to use a good quality shielded hook-up wire

When this section is completely wired a five terminal tag strip is mounted above it against the rear of the chassis. This carries the .05 meg. decoupling resistor and the 24 mfd electrolytic capacitor. However, the latter is not fitted until connections have been made to the incoming HT line, HT anchor point in the pre-amplifier section, and the HT connection to the oscillator section.

At this stage it should be possible, by completing a few connections temporarily, to apply power to the unit and test the preamplifier and oscillator. This is a worthwhile test, since it is much easier to correct any mistakes at this stage than later.

The pre-amplifier can be checked both for correct operating voltages and by connecting a microphone to the input and feeding the output into the pickup terminals of the set or amplifier. The oscillator can be checked by measuring the output with an AC voltmeter and in an unloaded condition it will deliver close to 1000 volts. Without the shield in place, it will be necessary to test the preamplifier without the oscillator in operation, otherwise radiation from the latter will probably overload it.

## COMPENSATION PAD

The next step is to make up the compensating T pad and wire the switch. The T pad components can all be mounted on an eight-terminal tag strip, and a general idea of the layout can be gained from the photograph. It mounts on the rear of the dividing shield and when in place the appropriate connections to the switch may be made.

To assist in the wiring of the switch wafers we have prepared drawings showing the positions of the various switch sections and contacts, the numbers corresponding with those on the circuit. We have also shown the actual wiring which is required on each wafer and this should assist materially if you are not familiar with switch circuit diagrams.

We would once again emphasise the need to follow the switch layout shown and that any variation from it will almost certainly lead to trouble.

When the switch wiring is completed and carefully checked the complete assembly of shield, T pad, and switch may be fitted into place and the few remaining connections made to complete the main portion of the wiring. The loudspeaker volume control has still to be wired, but it is advisable to check what has been done first, just in case there is a mistake and the shield has to come out.

If all is well it should be possible to connect the recording head and a microphone to the appropriate sockets and make a test recording, the only facility lacking being that of controlling the monitor speaker, and it will have to be temporarily disconnected to prevent feedback.

If the unit is being powered from a complete receiver it will also be possible to record radio programs by simply switching from the pick-up to the radio position and setting the adaptor to record. The main speaker may be left in circuit for this operation.

If these tests prove satisfactory the wiring to the speaker volume control may be completed. Three terminals are mounted on the end of the chassis, near the oscillator valve, and should, ideally, be colored or marked for easy identification. One terminal is simply earthed to the chassis while the other two connect to the switch and volume control respectively.

Although the circuit is a low impedance one, it is possible for coupling to occur between it and the pre-amplifier stage, and the wires from the terminals should be taken along the rear of the shield as far as possible before bringing them through to connect to their respective contacts.

With the volume control working correctly it will be possible to control the volume to the main speaker during recording, while the control will be automatically switched out for playback, thus removing the need to continually adjust this control for recording and playback operations.

## MODIFICATIONS

And, finally, a few comments about the type of equipment with which this adaptor can be used and what modifications are likely to be needed. The basic requirement is an audio amplifier having an input sensitivity of from .25 to one volt, and the usual power output of from three to four watts.

This may be either a seperate amplifier or the audio end of a complete receiver. In the latter case there will need to be access to the audio input,

(Continued on Page 96)


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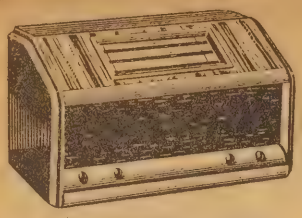

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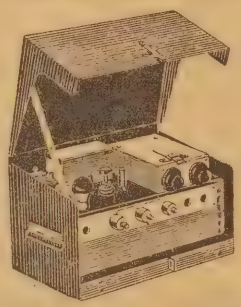

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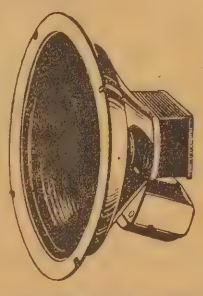

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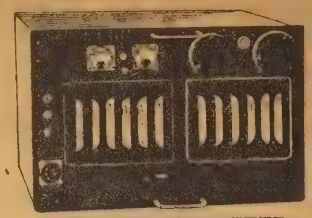

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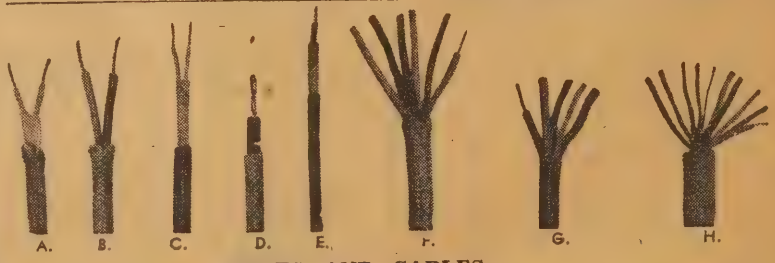


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# USING 24 VOLT GENERATORS ON AC

**Some years ago we printed an article showing how many 24 volt aircraft generators ex-disposals can be rewired to operate as 240 volt motors. As this article is now out of print, we are repeating it this month in response to many requests.**

MANY dealers in the disposal of ex-Government stock have on offer, at low prices, motor generators taken from aircraft radio equipment. These were built to take their supply from batteries given voltages in the order of 24 volts DC, and to give out various DC voltages from 270 to 1000 volts.

For this purpose the machines have two, or sometimes three, commutators, one to provide a passage for the actuating current, and the others for the collection of the current generated. It is important to note that there are *only one pair of field coils* and that these are (a) common to all windings, and (b) they are designed for low voltage work, and consist of relatively few turns of heavy wire.

Fig. 1 shows how these machines could have been wired in service, although it is possible that control resistances may have been fitted in some cases.

## SERIES CONNECTION

As most of the machines have both field and armature of laminated construction, the possibility of converting these DC machines as AC motors was obvious, and so dealers advertise that the machines either have been, or can be, so converted to run on the 200-240 volt AC mains.

Whilst it is true to say that they run when converted, they usually do so at uncomfortably high speeds and with a typical "series" characteristic, or, in other words they "run away" to a high speed on no load and when loaded slow down and down as the load increases and finally stop.

This occurs on series motors specially designed for AC work as anyone may prove by placing their hand over the nozzle of a vacuum cleaner so as to stop the flow of air. With no air to handle the load on the fan diminishes and the note of the motor rises sharply. This unpleasant habit of series motors is more than usually apparent when ex-aircraft generators "converted" as in Fig. 2 are used, the "conversion" consisting of placing the LT field coils (i.e., the only available field coils) in series with the lowest voltage of the HT windings.

## WEAK FIELD

For simplicity the diagrams show only one HT commutator, but there may be a second one of about 1000 volt output.

Owing to the small number of turns in the field coils, and the fact that the amount of current which can pass through them is limited by the HT armature winding, there are not enough ampere-turns to give a satisfactory field strength. This weak field in turn gives rise to two difficulties:

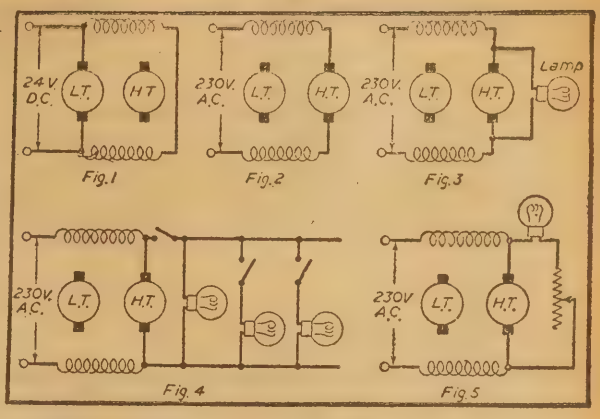
(1) The armature fails to generate the necessary back EMF and so goes on speeding up as the armature accepts more and more current.

(2) As the torque or turning power is produced by the reaction of the magnetic forces in the field

☆

Wiring diagrams for ex-aircraft generators, showing methods of passing more current through the field coils for the purpose of increasing torque.

☆





# CAMERA BARGAINS

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and the armature, it is clear that if the field is weak, there is nothing for the armature to "kick against" or react from, and, therefore, the torque is low.

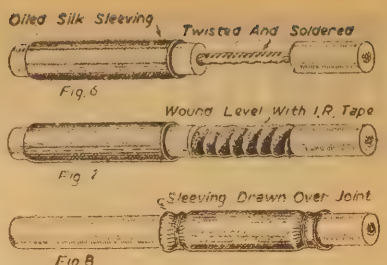
The obvious remedy for this state of affairs is to pass more current through the fields so as to make up for the shortage of turns, as a magnet winding of few turns fed with a heavy current can produce the same result as a winding of many turns fed with a smaller current.

To do this one must provide an alternative path other than the armature. In Fig. 3, this path can conveniently take the form of a lamp of main voltage, and of a suitable wattage. The exact wattage is best found by experiment, but some guidance may be had from the plate on the machine.

## TYPICAL CASE

For example, a machine in the writer's possession is rated at 24 volts 3.2 amps, for the low voltage end. As it was shunt-connected it was estimated that it would be safe to put at least 1 ampere through the field, but experiment proved that it was not necessary to do so.

As 200-300 volts AC current can be lethal, every precaution should be taken to see that the machine frame is earthed, and that all connections involved in making the conversion are thoroughly insulated.




Method of making a properly insulated joint in connecting cables

In some cases where wires pass down the carcase in the space not occupied by field coils there is not much room for them, and when they have to be extended to the HT end, the joints must not be bulky.

Figs. 6, 7, and 8, show a useful form of joint. A length of oiler sleeving or systoflex is chosen which will just slip over the insulation as in Fig. 6. The joint is then twisted and soldered and the insulation rebuilt to the original level preferably with raw rubber tape, or, failing this, with ½in insulation tape split down the centre. The systoflex sleeving is then slipped back over the joint and secured as shown, and should overlap the joint by at least ½in each end.

A touch of talcum powder on the tape eases the job of sliding the sleeve over the rubber or tape.

## PLASTIC

Referring back to Fig. 3, all lampholders used should be of the plastic type with skirts or lamp cap protectors, and all switches should be of the insulated type. All these fittings should be mounted on hardwood boards with the wiring on the underside, as in standard practice. It cannot be too strongly emphasised that loose experimental "hook-ups" on this sort of work are highly dangerous.

Having made sure of one's safety and having assured oneself that there is no danger of flexible wires being caught by the shaft or armature, insert a 15-watt lamp in the holder shown in Fig. 3, and switch on. The speed should be slightly less than with the current in Fig. 2. In turn insert 25, 40, 60, 100-watt lamps and it is probable that at some point in this range the motor reaches its slowest speed and maximum torque and increasing the wattage of the lamp gives no other result.

## THE LAMP

The lamp, which just produces the result is obviously the one required.

If, for example, the lamp required is one of 60-watts, it is clear that four 15-watt lamps or one each 25 and 40-watt lamps in parallel will produce the same result. Fig. 4 shows an arrangement which will give a series of speeds. With the switch nearest to the HIT commutator open, the motor runs at top speed, but, as the remaining switches are closed the speed falls by steps and the torque increases.

Fig. 5 shows a fully variable arrangement the lamp being of the maximum wattage needed to obtain the lowest speed while the variable resistance should be capable of carrying a load equal to the wattage of the lamp, eg, the resistance for a 100-watt lamp would need a resistance capable of carrying ½ amp.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## CAN ANTS SEE?

SOME ants, foraging for food, find their way back home by sight while other kinds of these insects guide themselves homeward by their sense of smell. Experiments show that the worker ants of two common British species use predominantly different methods of orienting themselves. The scent trail is laid down by one kind by means of a bodily secretion.

# A COURSE IN TELEVISION

(Continued from Page 47).

namely the storage effect of the mosaic. This property allows it to retain an "electron image" of the scene until the individual cells of the mosaic are periodically discharged by the scanning beam. The American "Iconoscope" and the British "Emitron," together with their "super"-versions are typical tubes exhibiting the storage effect.

The film image is projected onto the picture tube mosaic by the more or less conventional set-up indicated in figure 1. However, the fan system is so arranged and synchronised that it flashes a bright image on the mosaic only during the very brief interval that the scanning beam is blacked out between frames.

However, the mosaic retains the corresponding charge pattern long enough to allow for a complete scan, before a further image is flashed on to it.

## RETAINS PATTERN

Mechanically, this is achieved by modifying the usual rotating fan or shutter.

The standard projector shutter is a two-bladed fan, as in figure 2b. One sector cuts off the light while the film is moving, and is commonly referred to as the "shift" shutter. The second sector is there purely to double the picture repetition rate and is referred to as the "flicker" shutter.

For television purposes, the open sectors are reduced in width to about 14 degrees of angle, so that they pass light through to the TV camera for only a very brief interval. This is synchronised in the system to correspond with frame sych. interval, when the scanning beam is blacked out.

The pull-down time is no longer significant, the only requirements being that the film is stationary during the brief intervals when an image is flashed on to the camera tube screen.

Before reaching the sound head, of course, the movement of the film is smoothed out by a series of sprokets and flywheels, as in the conventional cinema projector.

**(To be continued.)**

# HERE'S YOUR ANSWER TOM

(Continued from page 59)

In a practical circuit you could have a switch with a number of positions selecting various values of condensers so that the balance of the tone may be adjusted to suit your taste. Alternatively, you could select the largest condenser you are likely to need and wire a variable resistor of suitable value in series with it so that the degree of attenuation can be varied.

Of course, this is only one of many types of tone-controls. The more elaborate circuits are arranged to allow separate control of both bass and treble, allowing either a boost or an attenuation to be obtained as required.

**What are the meanings of the terms "TRF" and "Superhetrodyne," and what is the difference?**

The initials "TRF" stand for Tuned Radio Frequency and refer to the type of receiver which amplies the signal by means of an amplifier tuned to the same frequency as the incoming signal. The amplifier may contain one or more valves and several tuned circuits.

After amplification, the signal is applied to a detector, which, in turn, passes it on to the audio frequency amplifier and thence to the loudspeaker.

However, in the case of a superhetrodyne receiver the incoming signal is mixed with a signal from a local oscillator, which results in the generation of a third frequency equal to the difference between them. The sum frequency also appears, but usually we are not interested in it.

The frequency of the local oscillator is usually adjusted so that the third frequency, or intermediate frequency, is lower than the signal frequency, with a result that amplifiers with better amplification and higher selectivity can be designed.

If the receiver is tunable, the local oscillator can be kept tuned to a frequency having a constant difference to the signal frequency. The tuning of the intermediate frequency amplifier need not then be varied.


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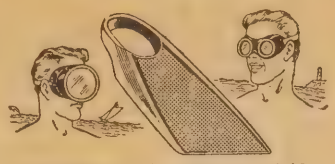

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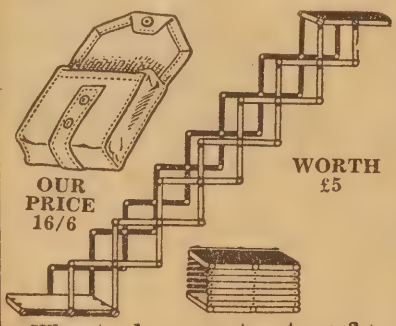

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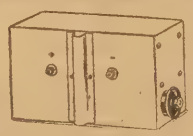

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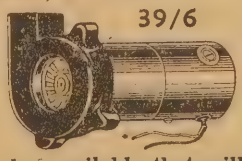

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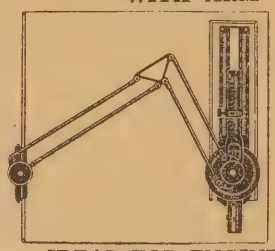

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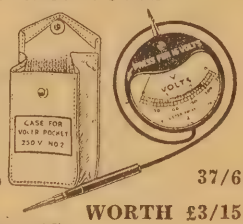

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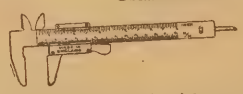

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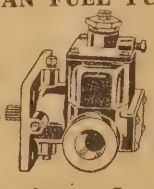

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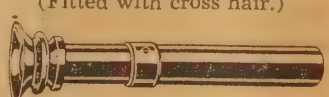

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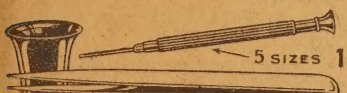


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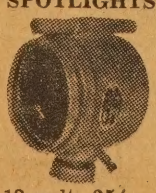

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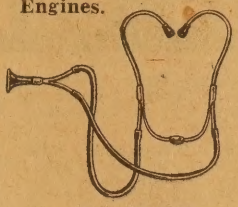

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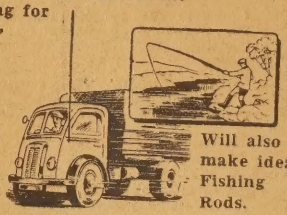

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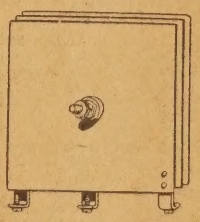

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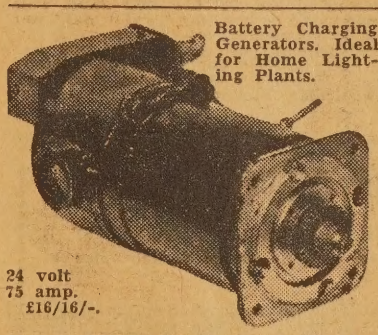

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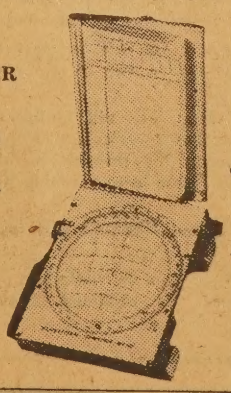

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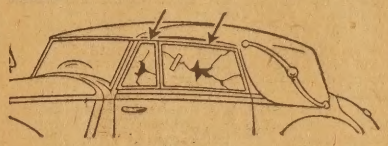

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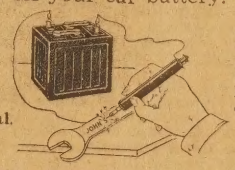

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# ANSWERS TO CORRESPONDENTS

**J. McK (Toorak, Vic.)** wants to know whether it is necessary to strip the insulation from insulated wire when using it as an aerial.

A: No, J. McK., the insulation makes no difference in this case. It is only necessary to remove the insulation at the point at which the lead-in is attached. There is an advantage in using insulated wire for the lead-in because it allows it to be brought through window frames &c, without the need for any other special precautions. You will, of course, use insulators at each end of the aerial proper.

**D.W.L. (Manly, NSW)** wonders if it will be possible to buy a single receiver to receive both broadcast and television programs.

A: If eventually we do have television in this country, it is probable that some manufacturers will turn out a unit capable of receiving both television and the ordinary broadcasting programs. However, the techniques employed for broadcast reception and those required for television reception are so vastly different that the unit would be virtually two receivers in the one cabinet. The position with regard to television is so uncertain that we would be inclined to advise you not to make it a consideration when purchasing a new broadcast receiver.

**E.T. (Rydalmere, NSW)** suggests that, in the "Playmaster" No. 3 control unit, the section of the 12AT7 at present used as a microphone preamplifier could be used in conjunction with a resistance capacity low-pass filter. His idea is that this would be more convenient than a voice coil low-pass filter.

A: As you say, there are advantages in the above arrangement and many readers would find it convenient. Possibly we will be able to do some work along these lines later. In the meantime, if you have an opportunity to try the scheme out we would be very glad to hear of the results. The main difficulty is likely to be the hum and instability which could arise from the extra stage. Chokes in low level stages are always troublesome. Many thanks for your kind wishes with regard to Radio and Hobbies.

**K.L.K. (Palm Beach, NSW)** suggests that many readers would be interested in an article on electroplating, particularly with cadmium and silver.

A: We agree, K.L.K. It is one of those things that we will have to do in the future. There are some difficulties from the point of view of experimenters but possibly these can be satisfactorily overcome. Many thanks for your favorable comments with regard to Radio and Hobbies.

**R. S. (Warrawee, NSW)** wants to know if there has been a 1952 issue of the Short Wave Handbook and also whether a certain commercial receiver would be suitable for short wave listening.

A: There has been no 1952 edition of the Short Wave Handbook R.S., but we still have a few of the previous edition and we suggest that you will find a lot of interesting material contained in it. It is available from this office, price 2/-. We have had no opportunity to test the receiver you mention and so we cannot comment. In general, however, the ordinary dual wave set leaves much to be desired for serious short wave listening and we imagine that this make would be no exception.

**E.C.S. (Christchurch, NZ)** enquires as to where the selenium rectifiers used in the Electronic Flash Unit may be purchased.

A: These rectifiers are handled in Australia by Standard Telephones and Cables, 252 Botany Rd., Alexandria, NSW and we understand that most of their present stocks have been released to various trade distributors who advertise in "Radio and Hobbies." We suggest that you contact those of our advertisers who have announced that they can supply kits for these units and also Standard Telephones and Cables direct.

**T.A. (Moss Vale, NSW)** requests that we publish the circuit of a simple transmitter. He also wishes to use dry batteries to operate the filament of the valve used in the amplified crystal set which was described as part of the "Learn While You Build" series.

A: A simple transmitter was described in the April 1952 issue of Radio and Hobbies and we do not have any immediate plans for describing another one. We would like to draw your attention to the fact that it is necessary to have a PMG licence before a transmitter of any sort can be operated. We discussed the matter more fully in a reply to "Tom" which appeared in the October 1952 issue. The current drain is too high for dry batteries to be an economical way of operating the valve filament you mention. If you are keen on battery operation the present "Teach Yourself Radio" series should be of particular interest to you.

**M.McG. (Toowoomba, Qld)** sends in for comment the circuit of a 5-valve T.R.F. receiver.

A: The circuit appears to be quite in order. The AVC circuit would be helpful in reducing "blasting" when tuning over strong stations but the gain between the aerial and the AVC detector would not be sufficient to control fading on weak stations. With no signal applied, the grids of the 6J7-G and the EBF32 are effectively at earth potential. However, as soon as the RF potential appearing at the AVC diode plate exceeds the cathode bias of the EBF32 the AVC system begins to work. In other words, there is a voltage delay.

**K.R.T. (Bendigo, Vic)** submits an idea which he suggests may help to eliminate surface noise from gramophone records.

A: We haven't been able to follow your idea very clearly but cannot see in it any factor which would affect surface noise in relation to signal. On the contrary, any addition to the mass of the moving parts—and this would seem to be involved—tends to accentuate resonance effects and make surface noise problems more acute. If you care to write again and explain just how you think the system would achieve the desired result, we will be pleased to comment further.

**R.D. (Ungarie, NSW)** is anxious to use both a crystal and light weight magnetic pickup with the No. 2 Control unit and wants to know how best to approach the problem.

A: The compensating pad for the Acos GP20 and similar pickups which were described in the November issue would be most suitable for interposing between the GP20 and the control unit. This would modify the output of the GP20 both in level and frequency response, to values more nearly equivalent to the magnetic type. The No. 2 Control Unit, in common with all of these series, is compensated for the magnetic pickups, a point which you have apparently overlooked. The presence of an additional volume control in the main amplifier should not complicate matters unduly, and it will probably be found that it can be left at one particular setting in most cases.

**M.H.S. (Camberwell, Vic.)** wants to build a receiver which, presumably, is to be tuned by a miniature radio link.

A: As it appears that you intend radiating a signal from one unit to another, it is necessary to ensure that such a signal does not extend beyond your own home or does not interfere with neighboring sets or any communication installation. Failure to take suitable precautions can lead to confiscation of the unit by the PMG's Department and the initiation of court proceedings. There is more than one way of achieving the result but the design of each would have to be controlled to fulfil the conditions mentioned. We are unable, however, to deduce from your letter just how you intend going about the job. We suggest that you have a chat with a local amateur or radio serviceman, bearing in mind the restrictions imposed by PMG regulations upon control signals.

**B.U. (Nth. Brighton, Vic.)** raises a query concerning the function of a transformer and a resistor.

A: We can appreciate your difficulty, B.U., in attempting to clarify in your own mind the functions of a transformer and a resistor when your source of information describes a transformer as something which "breaks down an electric current." Although this is a suitable subject for complete treatment in a "Here's Your Answer, Tom" article the story is briefly this. In very broad terms, a transformer is used to raise or lower voltage. For a given load upon the source, that is, for a given power consumption, an increase in voltage at the secondary winding means a lower current than in the primary winding while a low secondary voltage means a higher available current. When a resistor is inserted in a circuit passing current, the drop in voltage across it causes one end of the resistor to be at a different potential to the other end. If the current through the resistor changes the drop in voltage across it varies accordingly.

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# A REVIEW OF AMPLITUDE MODULATION

(Continued from Page 35)

operated resistor in series with the d.c. plate voltage of the r.f. tube.

Figure 5-A is the Heising or constant current circuit. In this arrangement, d.c. power is supplied to both r.f. and modulator tubes through the iron-core reactor L by the common source Ep. The modulator plate current is maintained by the d.c. grid voltage of the modulator at the same value as the r.f. tube plate current.

Variations in the modulator grid voltage (produced by excitation from the audio amplifier) cause corresponding changes in the modulator plate current, an increase in the negative value, causing a reduction in plate current, while a reduction in the negative value (or positive grid swing) causes the plate current to rise.

## INDUCED VOLTAGES

These plate current variations give rise to induced voltages in the reactor L, which are in the proper direction with respect to Ep to maintain the supply current steady.

When the modulator plate current increases, the amplifier plate current must increase, and vice versa. The total current thus remains constant through the action of the reactor, while audio-frequency variations in the plate current of the r.f. tube produce corresponding variations in the carrier.

For 100% modulation, the r.f. amplitude is modulated between twice its resting value and zero. In order to accomplish this in the Heising circuit, several modulator tubes would need be connected in parallel to reduce to the modulator plate resistance. (Actually, in order to secure complete modulation, the plate resistance would have to be reduced to zero.) Or the modulator plate must be operated at a higher voltage than that of the r.f. tube.

The latter method is most common and is accomplished by the series dropping resistor R which is shunted by the capacitor C, the function of the latter being to pass the audio voltage.

## USING TRANSFORMERS

Figure 5-B shows plate modulation employing a coupling transformer. The modulator may be a class-A, class-B, or class-AB amplifier of sufficient power capability. Here the a.f. power is superimposed upon the d.c. plate power input to the r.f. tube by means of the transformer. The audio voltage is thus effectively in series with the d.c. plate voltage of the r.f. tube.

The voltage required for complete modulation depends upon the a.f. voltage in the transformer primary, the turns ratio of the transformer, and the maximum d.c. power input to the plate of the r.f. tube.

When the a.f. power output is sufficient, complete modulation with low distortion and good linearity is obtained when the impedance of modulator and r.f. tube plate circuits are matched through the coupling transformer.

In plate-modulated systems, the audio power which must be supplied by the modulator is equal to one-half the d.c. plate power input to the r.f. stage. It is clear from the foregoing explanations that since the instantaneous plate voltage of an r.f. tube under 100% modulation will be increased to twice its normal value, the tube must dissipate a detrimental amount of power unless its "resting" plate voltage is reduced to a safe value.

For this reason tube tables indicate a lower value of plate voltage for telephony and modulated telegraphy than for unmodulated services.

Figure 5-C shows a grid-bias modulation circuit. Here, audio frequencies are introduced into the grid circuit of the r.f. tube through the coupling transformer T. This system utilises variations in the grid-bias of the r.f. tube to secure amplitude modulation of the carrier.

The peak grid voltage is varied by varying the d.c. bias at the audio-frequency rate, and the average power output is increased by the modulation process, although the d.c. plate power input remains constant.

## OBTAINING LINEARITY

Operating voltages and currents must be maintained at specific values in order to obtain good linearity of modulation. Especially important is the location along the grid characteristic at which the tube is operated.

These values are such that the plate-circuit efficiency of a grid-modulated stage is reduced to approximately one-half that of a plate-modulated stage. 35% is usual with grid modulation. Both excitation and bias voltages are set considerably lower than corresponding characteristics in class-C operation.

The carrier efficiency in a grid-bias modulated system is highest at the modulation peak. The carrier must be maintained at a value which is equal to half of its peak voltage, the modulated values being then swung up and down about this particular value. The carrier efficiency is accordingly termed one-half the theoretical possible efficiency.

Actually, however, the efficiency of grid-modulated r.f. amplifiers is approximately 35%. An advantage of the system is its low a.f. and r.f. power requirements. Very small audio levels will completely modulate the amplifier, while the actual r.f. excitation power reaching the grid need be sufficient only to overcome the grid losses.

A typical cathode-modulated amplifier is shown in Figure 5-D. In this circuit, the audio voltage is impressed across the cathode circuit. The cathode-modulated circuit may be considered to divide the modulation between plate and grid, the carrier efficiency being, as a result, intermediate between the two and usually 45%. Variations occur in both grid-bias and plate voltage during modulation.

## CATHODE MODULATION

Since the presence of a small amount of grid-bias modulation in this system tends to make the circuit behave somewhat as a grid-modulated stage, the output will not be so high as with plate modulation. The percentage of grid modulation is purposely kept small to increase the carrier efficiency.

The percentage of grid modulation may be controlled by adjustment of the grid leak resistance and the position of the grid return along the tapped secondary of the cathode modulation transformer.

As the percentage of plate modulation is increased, the required audio power (from the modulator) and r.f. excitation likewise increase, although both of these requirements will be small as compared with those of plate modulation circuits.

Figure 5-E shows the circuit for suppressor modulation of r.f. pentodes. Here, the audio-frequency component is introduced through the coupling transformer in series with the negative d.c. suppressor bias.

An extremely small amount of audio power is required to modulate an amplifier in this fashion, but the carrier efficiency, as in grid-bias modulation, is only about 35%, and distortion increases at about 80% modulation.

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# THE R & H TAPE ADAPTOR No. 1

(Continued from Page 87)

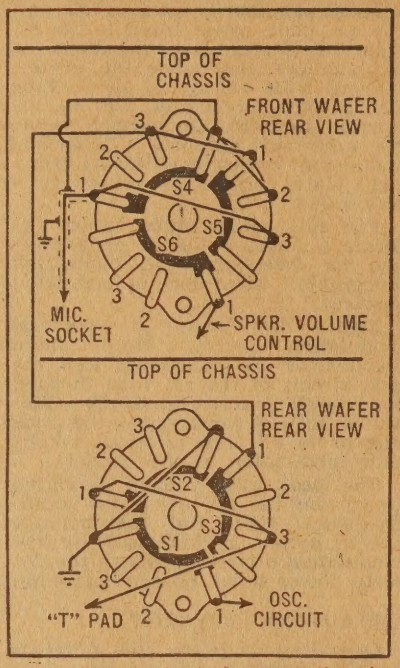
such as a set of pickup terminals, and it may be necessary to examine the chassis to determine just how these terminals are connected.

Ideally, the set should be fitted with a switch to connect the volume control to either the detector output or the pickup terminals as required. If not it might be advisable to fit such a switch, probably in some suitable spot on the rear of the chassis.

It is also important to watch the input impedance, which can be .25 meg. or higher, but should not be appreciably lower. You are most likely to strike trouble in this regard if the set is fitted with a pickup pre-amplifier stage designed for a magnetic pickup requiring a load of 25,000 to 50,000 ohms. Such a circuit will cause serious distortion in the pre-amplifier stage at very low levels. In such a set it would also be advisable to fit a switch and a pair of input terminals to make available the input to the volume control.

The next problem is to arrange connections to the filament and HT points of the main amplifier. Three possible methods suggest themselves: (1) An adapter to fit in the power valve socket; (2) A separate socket at some convenient point on the chassis, and (3) a group of terminals at some point on the chassis.

The adapter is quite a convenient system providing there is enough head room for the power valve when the adapter is in place. In many cases the same adapter will suit the majority of receivers and this is often a considerable advantage. Don't forget the earth connection between the two chassis or there will be a high voltage between them which can give a nasty bite.




This diagram shows the connections to the switch wafers.

A separate socket will appeal to many who have made their own amplifiers, such as the Playmaster series, and which have provision for an extra socket for a tuner or similar piece of equipment.

Terminals are not very convenient, but may have to be used when space is at a premium. Main objection is the danger of shock if they are handled while the power is on, though much depends on the type selected.

In order to provide control of the main speaker while recording, and this is essential when working from a microphone, connection must be made to the existing speaker voice coil circuit. In most cases it is not difficult to get at this part of the speaker, and it must be assumed that a reader who has the ability to construct the adapter will be able to find his way around this part of the set.

The connections can be followed from the circuit and it only remains to provide some easy means of making them when the adapter is to be used and ensuring that they can be easily restored to normal when it is no longer in use. Probably one of the simplest schemes would be to provide three terminals at some convenient point on the speaker frame; one connected to one side of the voice coil circuit and the other two when linked together, serving to complete the circuit between the transformer and voice coil.

Thus the voice coil circuit can be easily diverted to the adapter when required, or restored to normal by simply linking the two terminals.

When recording it will be found convenient to set the speaker volume control to such a position that the volume from the speaker is at a normal level when the correct level is being applied to the tape. This level is best found by experiment, too low a level causing excessive noise and too high a level causing distortion due to overload of the tape. Once the correct setting has been found the position of the speaker control should be noted for future reference.

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**SELL:** Williamson amplier £25. Veneered vented enclosure £20. Both as new. Details. **B. Walters, Kuranda, 14A Chalmers St., Sydney. MA4888 after 6.30 pm.**

**SELL:** C.R.O. type M/032 as used by RAN & RAAF. Provision for U.H.F. & trigger time-base 3in tube Cont. Variable T.B. 25-50,000 c.p.s. Separate power supply of 750, 1300 or 1900 V. Good condition & appearance, £30 or offer. Valve Tester (Paton, bench type) good order £10. V.T. V.M. 6 ranges, Weston Model 669 excellent appear. £7/10/-. **Oscilloscope, C/o 34 Iris Rd., Glen Iris, Vic.**

**SELL:** Disposal 16mm. Sound Projector, 101 Transceiver; AT5 Xmitter; R9/APN4 RX; Portable G'phone; Asstd. Valves; 1155RX; Qty. Receiver parts (too numerous to list), B'cast RX (mantel); 16mm Film — Chaplin comedy and gazette (silent); Copies R. and H., Radio World. **L. Schnitzerling, 72 Canning St., Warwick, Q.**

**SELL:** "GRAPHOSCOPE" 35 mm. Silent Cine' Projector. Complete with Motor Drive, Sprocket etc. In good order. Ring **Mr. Hughes, Australian Museum, B056 Ext. 2489.**

**SELL:** BC221 perfect condition. £30. **McLeod UF3445.**

**SELL:** Tom Thumb 2 valver IT4 3S4 described Aug. '47. Recently built £5/10/-. Phones £1/5/-, Speaker, 12/6. **19 Kilkee Av., Bexley North (off Miller St.)**

**WANTED:** "Calstan" D222 Valve Tester circuit diagram. **G. Sharrock, Taggerty Vic.**

**WANTED TO BUY:** Receiver type AR88 condition and price to **C. N. Cowan, 106 Aberdare Rd., Aberdare 3N, NSW.**

**WANTED:** 4015-A Transmitter valves. Good condition. Please reply to **81 Rochester St., Homebush.**

**RADIO TECHNICIAN** wants to help you building your rig or receiver set. 9/- an hour. Please write, **Box 6 P.O. Guildford, NSW.**

**NEW MEMBERS** are invited to join the newly formed Waverley Camera Group. Contact **Secretary, F. H. Green, 20 Wellington St., Bondi.**

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